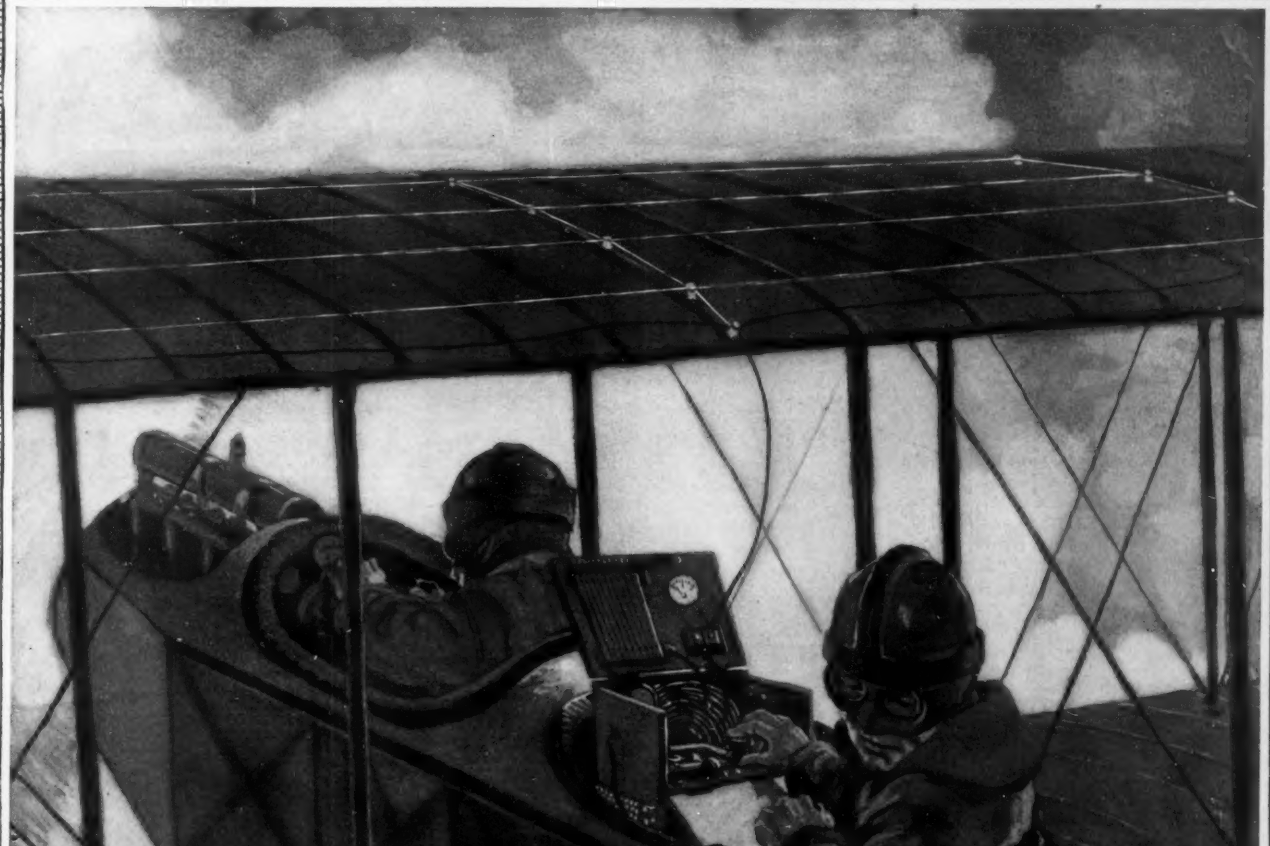
# SCIENTIFIC AMERICAN



THE AIR SCOUT AND THE WIRELESS TELEGRAPH

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# SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


*The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.*

## As to Alaska

IT is nearly half a century since we purchased Alaska. In the interim we have paid so little attention to this vast territory—the largest body of unused and neglected land in the United States—that it is inhabited by less than 40,000 white inhabitants—a gain of less than one thousand for each year since it passed beneath our flag. In the intervening forty-six years we have got from Alaska more than we have given; for it has repaid our inexcusable neglect by adding to our wealth through the yield of its mines, fisheries, and furs alone, more than $500,000,000.

To those who are interested in Alaska—and that should mean every citizen of this country—we commend the report of the Secretary of the Interior for the fiscal year ending June 30th, 1913, an illuminating document, well calculated to awaken a widespread national interest in this neglected country, and a sense of our national duty to provide for its intelligent and systematic development and government. The prospector has proved that no other section of our land makes so rich a mineral promise, and the Government has demonstrated that in agriculture, Alaska will produce in abundance everything that can be raised in the Scandinavian countries. It is estimated that there are in Alaska fifty million acres of land that will make homes for a people as sturdy as those of New England.

The Government has made a start by withdrawing Alaska from the too aggressive and self-serving exploiter; but, as yet, we have done nothing to substitute a safer servant of the public interests. If we are to bring Alaska into the early and full realization of her possibilities, we must create a new piece of governmental machinery for the purpose. Secretary Lane would establish a Board of Directors, and into its hands he would give all the national assets of that territory, to be used primarily for its improvement—its land fisheries, Indians, Eskimos, seals, forests, mines, waterways, railroads; all in fact, that the nation owns, cares for, controls or regulates. This board would have nothing to do with the internal affairs of the territory, and it would exercise no powers save such as Congress might grant over the property of the United States in Alaska.

The arguments set forth by the Secretary in favor of the above policy are convincing: In the first place, such a board would advise Congress as to what should be done, without prejudice and out of a deep national interest and with first-hand knowledge of conditions. It would co-ordinate the present enterprises of the Government. As matters stand, the control of land is in one department, of forests in another, roads in another, of fisheries in a fourth, and of railroads in still another department. As a concrete instance of these conditions which strikes us as positively funny, we are told that the care of black bears is in one department and of brown bears in another. Every one will agree with the Secretary, surely, that there can be no satisfactory administration of land laws, nor indeed of any other laws, at a distance of 5,000 miles from the point of action. Truly, "the eye that sees the need should be near the voice that gives the order." Alaska's opening and improvement should be treated as one problem, and each step of its administration should be part of a general plan, of a unified and consecutive programme based on immediate knowledge and conditions. The opening of land and the building of railroads or wagon roads, for instance, should be part of one general scheme.

The Secretary believes that Alaska should be developed, so far as possible, out of her own revenues and resources; that she shall have a federal budget of her own, her revenues and expenditures being presented to Congress on a single sheet. The funds raised from her lands and fisheries, her furs, her forests and her mines, should be used for the construction of her roads, railroads, telegraph and telephone lines, or for any other purpose which would make her resources more quickly available to the world. It is believed that Alaska is self-supporting to-day. That is to say, that by proper taxes and charges imposed upon those who are deriving large returns from their enterprises in the territory, such revenues could be derived as would support a large policy of expansion and improvement.

## Positive and Negative Natural Laws

THERE is something satisfying about a positive statement. To be told, for example, that the gravitational attraction between two portions of matter is equal to a certain known constant multiplied by the product of their masses and divided by the square of the distance between them, is to be given full and sufficient information to determine the gravitational pull between any two portions of matter whose masses and distance apart are given. Here the law is given in the form of an *equation*, which can be solved without ambiguity for any given case.

But not all laws of nature are of this positive type. We are still living in the age of the "heat engine"—our prime movers deriving their power in the great majority of cases from coal, oil or other fuel. Now the performance of which a heat engine is capable is *limited* by a law of physics—a negative law, for it tells us only what a heat engine can *not* do, it does not predicate anything positive about the performance of such an engine. A condensing heat engine dependent upon a source of heat (e. g., a boiler) at 380 deg Fahr. and performing the coolest part of its cycle at say 100 deg. Fahr., can not possibly have a thermodynamic efficiency greater than 33 per cent. For the second law of thermodynamics tells us that the efficiency of any *real* heat engine, working between two absolute temperatures $T_2$ and $T_1$ is less than $(T_2 - T_1) / T_2$. This law, unlike that of gravitation, is expressed by an *inequality*, for which there are necessarily an infinite number of solutions, thus leaving room for ambiguity.

Now it might at first sight appear that such a negative law would be of little practical value. But this is far from being the case, if only because it serves as a warning to us not to divert our inventive energies into fruitless channels. Any attempt to build a heat engine with an efficiency higher than the limit set by the law quoted, represents so much labor wasted—at least so long as we can not deal with individual molecules. This has sometimes been expressed by saying that "perpetual motion of the second kind" is impossible: Thus for example, without any violation of the law of conservation of energy, we might suppose that a vessel traveling on the ocean might derive heat from the practically unlimited source provided for it in the ocean, turn this heat into work for propulsion of the vessel through the water, and at the same time return it to the sea by the friction of the ship's hull against the water. The sea would lose none of its heat, since what was taken from it for the ship's motors would presently be returned to it by friction. Therefore, it would seem, this process might be continued indefinitely. But such "perpetual motion of the second kind" is impossible—the law stated above bars all possible avenues to it.

So far, in fact, from useless are negative laws of nature, that this form is sometimes given to laws which are capable of being stated in the positive form. Thus the first law of thermo-dynamics, the law of conservation of energy, is sometimes stated to the effect that "perpetual motion of the first kind" is impossible—that energy can not be extracted indefinitely from a system which does not undergo some compensating change in the process, but returns at the end of the operation in every respect to its initial state. The value of this negative statement, again, is that it deters the cautious inventor from wasting his efforts in a fruitless quest. We say the *cautious* inventor, who takes the pains to inform himself of the knowledge acquired by others before launching out upon original work. Unfortunately there is never wanting an army of "inventors" lacking this caution, hence the daily growing literature on "perpetual motion" devices.

## Limiting Motor Trucks to Preserve the Roads

IN Maryland, and probably in New York and several other States, at this winter's sessions of the legislatures, efforts are to be made to enact measures intended to preserve the public roads and bridges by restricting the weight and speed of motor trucks, traction engines and other vehicles.

Bills of this nature were passed last spring in Massachusetts, New Jersey, and Pennsylvania, and this fall the Commissioners of Highways of New York State issued a set of regulations based on the Massachusetts law. The Bay State and the Empire State regulations limit the gross weight of vehicles with load to fourteen tons, and the weight on any one wheel to 800 pounds per inch of nominal width of tire. They also limit to fifteen miles per hour the speed of vehicles weighing more than four tons with load, and to twelve miles an hour vehicles weighing more than six tons if fitted with rubber tires, or to six miles an hour if fitted with iron or steel tires.

Leading motor-truck manufacturers concede that these limitations are reasonable and are not opposed to them so long as they are enforced equally against all kinds of vehicles and objects moved over the roads. As a matter of fact, there are very few motor trucks in existence that have a rated capacity of more than five tons and which weigh, with full load, more than ten tons. Out of approximately 80,000 commercial vehicles now registered in the United States, less than 400 will weigh as much as fourteen tons with full load, and these are used mostly in large cities where pavements are strong enough to support them. Only a little more than 1,200 out of the 80,000 are of more than five tons rated capacity; for it has not been demonstrated satisfactorily that the larger sizes are economical of operation, at least when fitted with rubber tires. These figures, which are authentic, make it appear that the advocates of weight restrictions are needlessly apprehensive, so far as motor trucks are concerned.

Speed and narrow iron tires on heavily-loaded wagons are more destructive of roads than mere weight, especially when this weight is carried on wide rubber tires. All leading tire manufacturers recommend loads considerably less than 800 pounds to the inch of width for their tires and seek to discourage loading them beyond the specified weights.

The speed limitations of the Massachusetts and New York regulations are not objected to by the motor truck manufacturers, who have striven long and earnestly to discourage overspeeding as well as overloading of trucks. The automobile manufacturers' national association, the Automobile Chamber of Commerce, has adopted standard truck speed ratings that are slightly below the limits fixed by the State regulations, and the standard form of warranty issued with the sale of each truck provides that overspeeding and overloading will void the warranty.

Nevertheless, the manufacturers believe that legislation directed specifically at motor trucks is unnecessary, and that it will have a tendency to postpone the building of permanent roads suited to motor traffic and the rebuilding and strengthening of antiquated bridges of which too many remain. They object to the implication which such legislation carries with it, that the motor vehicle is the only type of vehicle that damages the roads; whereas the highway commissioners and engineers who are advocating these measures never have brought forward any record of scientific observations to show the actual kind and amount of damages done, and they themselves admit that heavy teams are one of the most injurious factors in highway traffic.

Yet owners of automobiles and motor trucks are the only persons who are required to pay a specified tax for the use of the roads; and this is one of the reasons why the motor interests oppose this form of double taxation and discrimination. They are heartily in favor of good roads, but they object to having the funds raised by taxation of motor vehicles applied to building and maintaining types of roads unsuited to motor traffic—particularly when it is through their efforts that large road appropriations have been secured from State legislatures.

Any laws that are passed to regulate motor trucks should be made uniform with those now existing in the largest and most important States. An attempt is now being made by special commissions, appointed by eleven Eastern States, to harmonize the differences that exist between the present motor vehicle laws and to recommend one uniform law for all. Nothing done at this winter's sessions of the legislatures should be allowed to make this task more difficult. It would be better to defer legislation than to create new laws or provisions that might have to undergo radical changes within a year, if the uniform law recommended by the joint commission should be adopted.

## Volcanic Eruption in the New Hebrides

THE volcanic island of Ambrym, in the New Hebrides, was recently the scene of one of the most violent eruptions in its history. British and French officials, who visited the scene in the French cruiser "Kersaint," found the western coast of the island, between Dip Point and Banlaw, covered with ashes and scoria, which had fallen continuously for five days, while vast streams of lava had overwhelmed the Presbyterian mission hospital, French and English trading stations, cocoanut groves, etc., but no loss of life was reported among the few European residents. Most of the natives have been transported to another island. Many hundred natives are believed to have perished.

## Engineering

**Wash Your Smoke.**—The New York Edison Company has perfected an apparatus for eliminating the smoke and cinder nuisance at its great Waterside station, New York. The smoke from the boiler plant, laden with soot and cinders, is driven at high speed through a sheet of water, by means of which practically all of the material which constitutes a nuisance is deposited in a big water tank. The recent test showed an average efficiency of extraction of 95 per cent.

**Germany's New Gun.**—According to the *Army and Navy Journal*, the new gun mounted on the "Ersatz Wörth" and battleship "T" is a Krupp 15-inch piece, presumably 45 calibers in length, which weighs 75 tons and fires a projectile of 1,667 pounds with a charge of 531 pounds of smokeless powder, at an initial velocity of 2,789-foot seconds, and with the resulting enormous muzzle energy of 90,380-foot tons. The possession of such a gun means the ability to hit hard and accurately at very extreme ranges.

**A Larger Navy for Defense.**—Representative Hobson, in explaining to the House why he considered that the United States was only a third-rate power, referred to the fact that our present small navy, merely in the performance of its police duties, would have to guard 30,000,000 people and 37 billion dollars' worth of property that were concentrated along our seaboard and actually within gunshot of a hostile fleet. He stated that America has more lives and property exposed to such attack than has all the rest of the world combined.

**The "Aquitania's" Engines.**—The new Cunard liner "Aquitania," which is due in this port early in the coming year, will possess the largest turbine engines ever built. They will weigh 1,400 tons, and they will contain over 1,000,000 blades, varying from 1½ to 20 inches in length. The engines will contain high, intermediate, and low pressure turbines, and will be marked by other improvements suggested by the extensive experience gained by this company with the turbine-driven "Carmania," "Lusitania" and "Mauretania."

**Small Navy Yards Should be Abolished.**—We are glad to note that the present Secretary of the Navy has stated that it will be his policy to reduce expenditures ashore and use the money so saved for increasing the navy afloat. Rear Admiral Wainwright, who is a strong advocate of building four battleships this year, states that, if the Government would see fit to do away with the small navy yards and increase the capacity of the larger ones, much of the annual expenditure could be used in other directions. In no direction could the money so saved be used to better advantage than increasing the appropriations for new ships.

**Lifeboats and Davits.**—The International Committee sitting in London has recommended that lifeboats be provided for all on board. If this recommendation be widely accepted, we hope that the future type of lifeboat and davit will be modified to meet modern conditions. Both the lifeboats and the handling gear should be greatly increased in size, accommodation and speed of control. The lifeboat of the type used on the "Titanic" was wofully out of date. Thirty-ton motor-propelled boats, capable of accommodating 250 people, and handled by powerful electrically-operated davits, should constitute the equipment of the large passenger steamer of the present day.

**Non-magnetic Rails and Track-signaling.**—According to our contemporary *The Engineer*, in order to accommodate the increasing use of track and signaling circuits on railways, with the necessity for bonding joints, points, and crossings, and separating rail sections to form the desired electric circuits, it is proposed by a German engineer to use non-magnetic rails. The non-magnetic track rails are made of nickel steel containing about 18 to 20 per cent of nickel, and they are inserted at desired points in the ordinary magnetic track for controlling signals, brakes, etc., from the vehicles. For light railways, the whole of the track may be formed from these rails, which do not affect the action of the weak electric current used in controlling the railway.

**The Transatlantic Record.**—The present transatlantic record is four days, ten hours from the coast of Ireland to the entrance to Ambrose Channel, New York. It was made by the "Mauretania." The "Lusitania," on her last westward passage, in spite of strong winds and head seas for the whole voyage, crossed in four days, eighteen hours, five minutes. This performance gives promise of the "Lusitania's" surpassing the record of her sister ship under favorable weather conditions, for during the above-mentioned trip, for a period of eight hours, she made 197 revolutions and averaged 27 knots, and for one hour of this time her revolutions reached 207, the equivalent speed for which would be nearly 28 knots. It is likely that during the present year the record average speed across the Atlantic of 26.01 knots will be considerably exceeded.

## Electricity

**Electric Blasting to Prevent Tuberculosis.**—The gold mining companies of the Rand field, South Africa, have been experimenting with electric blasting with a view to reducing the danger of miner's phthisis, a disease which is very widespread in that region, and is laid to the fine dust resulting from blasting. By using electric systems the firing can be done from the surface and the air can be cleared of the fine dust before the miners need to enter the mine.

**Experiments in Electroculture** carried on by the U. S. Bureau of Plant Industry during the past year have not had encouraging results. Electrically treated plats of wheat gave an increased yield of only one half bushel per acre above that of the check plats. In 1912 an increase of two bushels per acre was obtained. None of the experiments conducted by the Bureau has so far indicated that electroculture is practicable from a commercial standpoint.

**Electricity Supply in London.**—Considerable agitation has been stirred up in London, following the address delivered before the Institution of Electrical Engineers by Prof. G. Klingenberg, Ph.D., on the subject of electricity supply in large cities. He compared conditions in Berlin, Chicago and London, showing that in the first two cities only six power stations are used in each city, whereas in London there are 64, and he showed how much more economical it would be to employ a few large stations. He suggested the substitution of a large power station for 25 of the existing stations.

**A Wireless Weather Service on the North and Baltic Seas**, under German auspices, has been in operation since the first of last July. The radiotelegraphic stations at Borkum, Heligoland, Norddeich, Cuxhaven, Bülk, Swinemünde and Danzig are regularly supplied by the Deutsche Seewarte, at Hamburg, with telegraphic information enabling them to advise vessels at sea, on request, of the current barometric conditions over Europe and the winds likely to prevail over the North Sea, the Western Baltic or the Eastern Baltic, according to which of these regions is specified in the inquiry.

**Magic Wand.**—A curious magic wand has been developed in France. It is worked by the action of a concealed magnet, so that a mouse or other small animal appears to run up and down the wand in a mysterious way. The wand is a square tube of light wood covered with silk, and the animal is of celluloid and has a small piece of iron on the bottom. Inside the rod is a small lead weight on an endless cord, and when the wand is turned up, the weight falls gradually and draws along a small magnet, also fixed on the cord and just below the surface. When the rod is inclined, the rat thus climbs up to the top, and this can be repeated as often as one may wish.

**Electrically Operated Moving Targets.**—Moving targets are used in Germany which are mounted on trucks and drawn along the ground by the use of electrically worked cables and drums, so as to approach real conditions. In the electric plant is a large motor driving a number of drums, one for each cable and its target, the speed varying as desired. Silhouettes representing infantry are drawn along, at first slowly, and when fired at they run at a rapid rate till they reach the first trench, stopping and lowering automatically so as to show only the head. Other maneuvers for infantry or cavalry can be carried out, and the electric method allows of a good control of operations.

**Summoning Police by Train Wireless.**—The wireless equipment now used on the Lackawanna trains has proved very serviceable on a number of occasions. Recently when an engine broke down, a new engine was summoned by wireless communication and much time was saved. Only the other day the new means of communication was employed to summon two of the road detectives in order to arrest suspected crooks who were found riding between the baggage car and the tender. The detectives were on hand when the train pulled in at Binghamton and placed the men under arrest. No doubt wireless communication between stations and moving trains will prove useful in a thousand and one unexpected situations.

**Concrete vs. Wooden Poles.**—An electric service company in Abilene, Kansas, is manufacturing its own poles of reinforced concrete owing to the limited supply of timber poles. The poles are cast in three-piece wooden molds and range from 20 feet to 35 feet in length, with a diameter ranging from 6 inches at the top to 10 inches or 13 inches at the bottom, depending upon the height of the pole. The poles are octagonal in shape, and have a hollow galvanized iron core, consisting of a pipe ranging from 6 inches in diameter at the base to 2.5 inches at the top. They are reinforced with 4, 6 or 8 bars. The cost of making these poles in sizes of 20, 25, 30 and 35 feet is $2.43, $3.85, $5.86, $7.57 respectively. Cedar poles of the same sizes would cost respectively $2.00, $3.95, $6.65 and $10.20.

## Science

**Daylight-saving in British Columbia.**—The latest part of the world to fall a victim to the daylight-saving fallacy is British Columbia, where the provincial legislature has been petitioned to advance the standard time now in use one hour from the first Sunday in April to the third Sunday in October. In support of this petition it is stated that British Columbians now sleep during three hours of daylight in summer.

**Aniline Dyes in Persian Carpets.**—It is believed that about 70 per cent of all carpets now woven in Persia contain at least some aniline colors. The Persian government some years ago prohibited the use of aniline dyes, in order to maintain the prestige of the carpets made in that country, but now merely imposes a tax of 6 per cent on the value of exported carpets in which these colors are used. The United States is believed to be the largest purchaser of Persian carpets.

**The Marine Meteorological Charts** heretofore published monthly for each of the oceans and for the Great Lakes by the U. S. Weather Bureau have been discontinued, and hereafter the only charts of this character issued by the Government will be the Pilot Charts of the Hydrographic Office. The Weather Bureau will, however, continue to collect meteorological log-books from mariners all over the world and to work up the valuable data they contain, subsequently turning the digested material over to the Hydrographic Office for use on the charts.

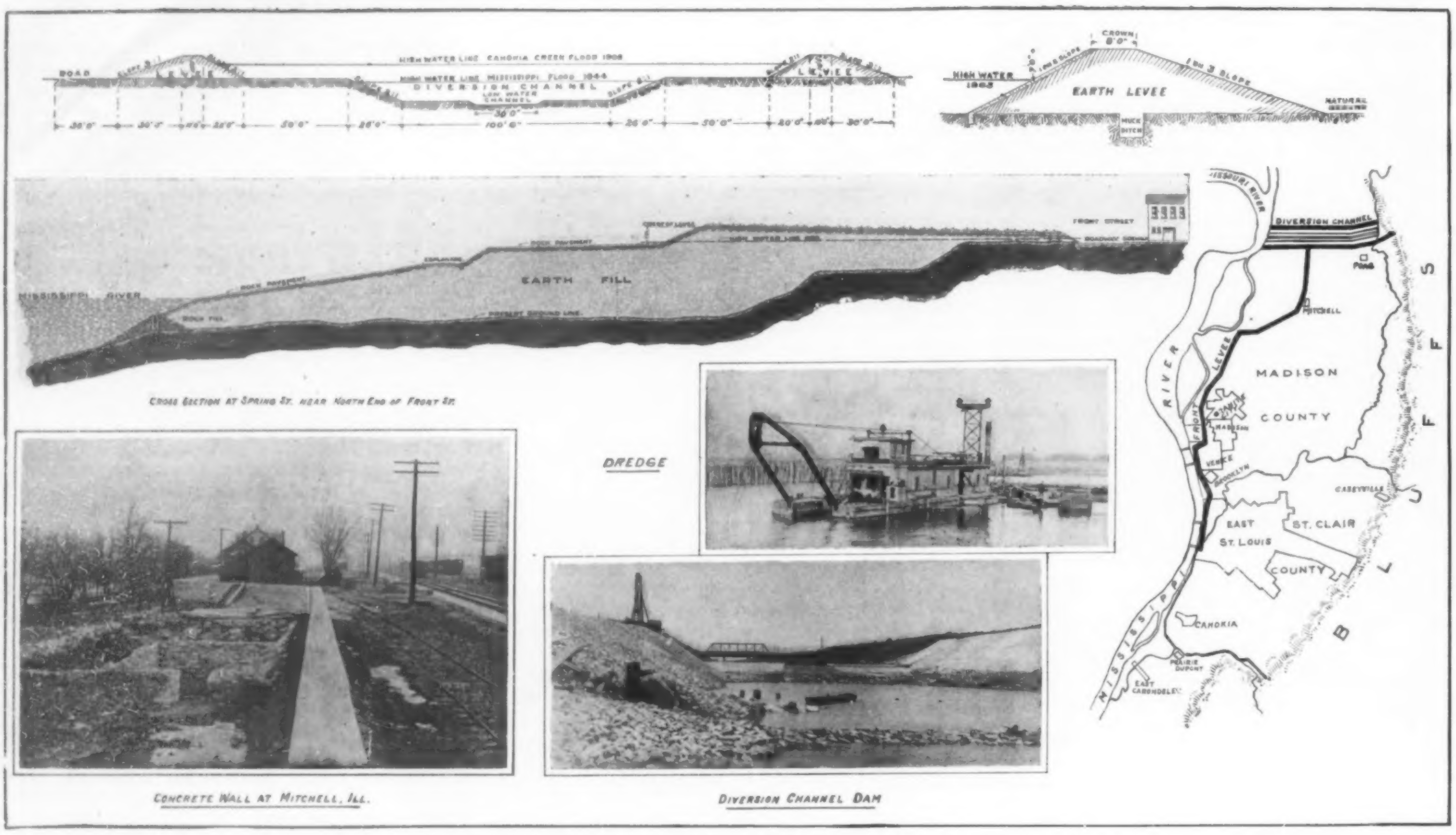
**Soot-fall Observations in England.**—As a result of the Smoke Abatement Conference held in London in 1912, and of the permanent Committee for the Investigation of Atmospheric Pollution, regular and systematic observations of soot-fall were begun October 1st, 1913, in the various London boroughs and 12 other important towns and cities in Great Britain with the standard instruments devised by the committee. Bailie W. B. Smith, who has charge of this work in Glasgow, recently visited the United States and endeavored to interest the municipal authorities at various places in this country to undertake similar observations.

**Newspaper Botany.**—Monsieur Jourdain had been talking prose all his life and never knew it until his professor told him. A certain Congressman, a couple of sessions back, immortalized himself by asking, "What are mammals?" And now Miss Lurana Sheldon and the literary editor of the *New York Times* (to say nothing of the exchange editors of the newspapers—among them the *Washington Post*—which have copied Miss Sheldon's poem without a *sic* after the word "fungus") are responsible for giving botanists a severe shoc . The poem is entitled "Mistletoe Vows," and opens with the following stanza:

> "Vow to me now,"
> Said the innocent lover;
> "Vow to me now!"
> Boldly he glanced at the fungus above her—
> The mistletoe bough.

The museum of newspaper bulls has not received a more piquant addition since *Leslie's Weekly*, a few months ago, referred to the late Alfred Russel Wallace as "the distinguished English caricaturist."

**Bradley Land: Dr. Cook Redivivus.**—In an interesting and plausible little book lately published by Mr. Edwin Swift Balch, "The North Pole and Bradley Land," an energetic attempt is made to rehabilitate the character of Dr. Frederick Cook and to prove that he may, after all, have been the first man to reach the North Pole. The main points in this contention are that (1) no one has proved that Cook did not reach the pole, and most of the arguments tending to discredit him have been more or less irrelevant; (2) Cook's description of the physical conditions encountered in high latitudes tallies strikingly with Peary's; and (3) Cook's detailed account of a previously unknown land, to which he gave the name of "Bradley Land," needs only to be confirmed by some future expedition (e. g., Macmillan's or Amundsen's) to furnish a strong argument in support of the veracity of his whole narrative. Cook's "Bradley Land" lies considerably to the north of Peary's "Crocker Land," which Macmillan's expedition is hoping to rediscover and explore. Both lands were sighted at a distance by their discoverers, but not visited. Cook describes the new land, seen from his line of march, as giving the impression of two islands, though they may be part of a large land extending far to the west. Along its southern coast the land had an irregular mountainous sky line, and was perhaps 1,800 feet high. Farther north its upper surface was flat and mostly ice capped, rising in steep cliffs to about 1,200 feet. Mr. Balch points out that the verdict of the University of Copenhagen, which has militated so strongly against Cook's claims, was merely "not proven," that the ascent of Mount McKinley by Cook can never be proved or disproved, and that "from time immemorial travelers have been called liars."




**Protecting East St. Louis against floods. Plan of district and details of the channels and levees.**

# Protecting East St. Louis Against Floods

## How a Large Industrial Center Was Rendered Permanently Secure Against Inundation

### By Tampton Aubuchon

THE East Side Levee and Sanitary District of Illinois extends about thirty miles along the Mississippi River, and is bounded on the east by a chain of bluffs. Within the area is a large industrial center. The principal city in the area is East St. Louis, which has a population of 80,000. The area is comparatively low and the Mississippi River formerly spread itself over a large portion of it. Through the area runs a stream called Cahokia Creek. Lying northwest of the area is a two hundred square mile plateau, which forms a water-shed for Cahokia Creek. Practically all of the waterfall of the plateau was formerly carried through the lower area by the Cahokia Creek to the Mississippi River. In the event of a heavy rainfall water from the plateau would augment the drainage of the lower area, and the Cahokia Creek would overflow its banks in the lower area. High water in the Mississippi River and the Cahokia Creek would frequently occur at the same time. The Mississippi River water backing up into the channel of the Cahokia Creek would meet the downward rush of the water from the plateau and the result would be a disastrous overflow. The Mississippi River inundating the area from the west and the Cahokia Creek overflowing in the central part furnished enough water to almost submerge the area. These overflows occurred frequently and caused great inconvenience to traffic and devastation of property.

*The Diversion Channel and Flood Gates.*—The problem of harnessing the troublesome Cahokia Creek was partly solved by the Diversion Channel which relieves the lower area of the drainage of the plateau. At the mouth of the Cahokia Creek flood gates have been built to prevent the Mississippi River from coming up into the Cahokia Creek Channel. The Diversion Channel prevents overflow from the north and the flood gates prevent overflow from the south. To protect the area against the high water of the Mississippi River the engineers have built a levee 31 miles long and seven feet higher than the flood record of 1903, which was 38 feet.

Let us begin our tour of the levee work at the extreme northern point. About where the Cahokia Creek emerges from the bluffs we find the Diversion Channel, 100 feet wide and 20 feet deep, taking the headwaters of the Cahokia Creek westward by a direct line to the Mississippi River. On both sides of it are clay dykes ten feet high. It absolutely eliminates all danger of overflow from the rainwater of the plateau. The clay dyke on the north side of the channel was built there to prevent overflow and the clay dyke on the south side of the channel is the north levee of the area.

At a distance of four miles from the head of the Diversion Channel we find a dam over which the water plunges to a level seven feet lower. On each side of the dam for a distance of about 250 feet the banks are protected with a facing of concrete and rip rap two feet thick.

The purpose of the dam is to check the flow of the water. The water which is now passing through the Diversion Channel for a distance of four and one half miles, formerly traveled about thirty miles through the lower area to the Mississippi River. The level of the bed of the Diversion Channel at its head is about twenty-five feet higher than the low water level in the Mississippi River, so that the water in the channel traveling four and one half miles, if it were not for the dam, would be falling at a rate of about five feet to the mile. Water falling at a rate of five feet to the mile is moving along at a dangerously high speed—a velocity which causes a stream to eat away its banks, undermine bridges and indulge itself in many disastrous pranks. To prevent such a condition of affairs the engineers have built the dam so as to allow the water in the Diversion Channel to have a fall of two feet to the mile. Thus the destructive head-waters of the Cahokia Creek reach the Mississippi River without tearing things asunder on their way.

Leaving the Diversion Channel, we start south and notice that the river front levee is about a mile and a half from the Mississippi River. There is no engineering reason for building the levee so far from the river at this section. The property owners in that territory which lies west of the levee did not care to bear their proportion of the expense of the levee work, so the levee was built along the least expensive route, which is back of their property, leaving them exposed to the Mississippi River high water. At Mitchell we pass a concrete wall, five feet wide at the bottom, two feet wide at the top, five feet high and one quarter of a mile long.

Leaving Mitchell we go westward to a point opposite Chouteau Island. Here the levee turns to the southwest. We move southwest until we reach Venice, where the levee approaches the river front. Provision had to be made for the drainage of the towns of Granite City, Venice and Madison. During high water the drainage of these towns is pumped across the levee through a concrete sewer. The water supply of Granite City, Venice, and Madison is pumped through pipes which run under the levee. To guard against any damage to the levee which might result from the bursting of those pipes a concrete jacket was built around that section of them which is immediately under the levee.

The drainage of the roads along the inner side of the levee during low water is conducted through the levee through automatic flood gates. The automatic flood gates hang vertically and operate like a transom. When the Mississippi River is high, its pressure being greater than the pressure from within, closes the gates. When the river recedes the drainage water presses against the gates and opens them. So far we have noticed that the levee is almost entirely made of clay, and we see the blue grass growing plentifully on both banks. Later the entire levee will be faced with concrete. In the meantime, the inhabitants of the area enjoy flood protection.

At Chouteau Island we turn to follow the levee southward. The levee reaches the river front at the Merchants Bridge. The Merchants Bridge approach is utilized as a part of the levee scheme. That side of the approach which is exposed to the current of the river was armored with a heavy facing of concrete. Just south of the Merchants Bridge approach the engineers have protected the levee with a heavy facing of rip rap. If the levee were not thoroughly protected at this point it would be likely to be badly damaged if not washed away during high water.

South of the Merchants Bridge the levee is faced with a semi-metallic substance, called slag, which is obtained from the steel foundries in the neighborhood without cost. The action of the elements upon the slag and foundry sand mixture causes it to pack and forms a solid mass with a hard surface.

As we go south we see a dredge anchored in the river and a large pipe floating on steel pontoons. Projecting out of the water at a considerable distance from the shore we see two rows of piling. These mark the new shore line. Back of the levee at this point the district board and property owners are raising the 150 acres of ground about 25 feet. They are doing it by means of an electrically operated dredge, equipped with a 20-foot centrifugal pump driven by a 1,000 horse-power motor.

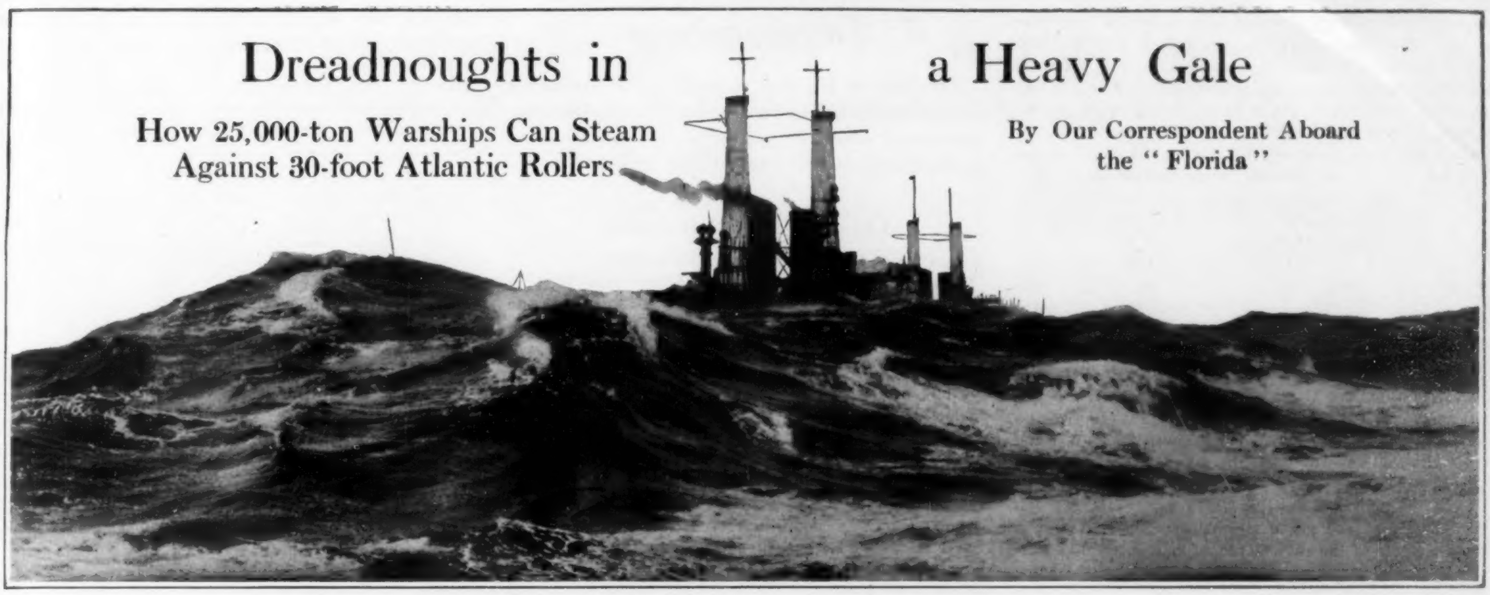
As we move southward we come to the concrete levee in front of the principal city, East St. Louis. A new shore line is being established in front of East St. Louis, and the dredge which is now working farther north

(Concluded on page 56.)

# Dreadnoughts in a Heavy Gale

## How 25,000-ton Warships Can Steam Against 30-foot Atlantic Rollers

By Our Correspondent Aboard the "Florida"



IT is the weather element among the many that combine to make up the efficiency of a battleship which is discussed in the present article. The subject is particularly timely as there is a strong probability that Congress will authorize two, or, perhaps, three dreadnoughts this year and the performance of these types under all conditions, but especially in rough weather, is closely watched and studied by naval constructors with a view to bettering the same design in the future.

This type of battleship was put on trial during the homeward passage of the Atlantic fleet from the Mediterranean, where it had been visiting various Italian and French ports. About one thousand miles from New York the fleet encountered a storm, which, for 24 hours, buffeted these great ships about as though they had been mere toys. At one time during the storm the wind was blowing at a rate of 90 miles an hour, and the sea was running so high that it was considered on the flagship whether it was not advisable to deviate the ships from their true course so that the immense waves would not be taken head on.

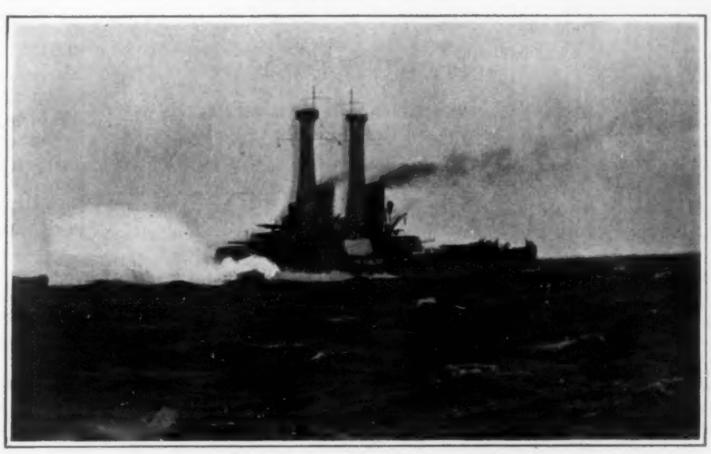
Never before had the dreadnoughts met with such weather, and even the blow encountered off Hatteras in 1912, which scattered the fleet and delayed it for several days, was mild in comparison. Some of the old, experienced men even went so far as to call the storm a typhoon. Rear Admiral Charles J. Badger, commander in chief of the fleet, ordered it to head into the teeth of the storm at a speed of 12½ knots, which, because of the friction of the wind and waves, was reduced to about 9.

The dreadnought "Florida," upon which I was a passenger, was third in line. The "Arkansas" and the "Utah" were ahead; the "Delaware" was behind, and the "Wyoming" and "Vermont" were some five miles to the south'ard. During the most violent part of the storm the "Vermont" was disabled by a broken propeller shaft and the "Delaware" went to its assistance.

As the storm was heralded by dangerous "mares' tails" and a rapidly falling barometer, everything was battened down and secured. All hatches were dogged down, the deck ventilators closed, and an extra turn taken on the dogs of the gun ports. We turned in hardly knowing what to expect.

A succession of deafening crashes at the bows awakened everyone in the officers' quarters at about 5 o'clock in the morning. The ship was pitching and straining terribly, the air below decks was already becoming foul and for the first time I felt "squeamish." A bath would have helped some; but the forward compartment had several inches of water on its deck, and with every pitch and heave more water would find its way through the "non-returning" valves and shoot up through the drains in green geyser-like spouts. This condition existed as long as the sea continued. After a great deal of effort I reached the bridge, which, high as it was above the water—about fifty feet—was enveloped in solid sheets of green water tossed high by the bow and hurled aft at express train speed. It was simply impossible for a man to stand the force of the wind and water as it drove across the bridge. By watch time, by stadimeter measurement, the crests of the waves were something more than a quarter of a mile apart.

**Rising to a big sea.**



**The "Utah" throws a sea from her flaring bows.**

**How it looked from the bridge of the "Florida."**

The bow of the "Florida" was smashing up and down at a rate of five times a minute, reaching limits of vertical rise and fall nearly fifty feet apart. During the first thirty feet of the drop the force of gravity had full sway. The flare of the bow caught the sea and for an instant checked the drop only to lose its hold an instant later, when down went the bow again for twenty feet more. As the bows of the dreadnoughts are very pointed with a flare at the top, there was but little resistance furnished against the first period of downward drop.

With her deck at an angle of ten degrees to the horizontal, the "Florida" mounted the great waves. They passed under, leaving the bow high in the air. At times, more than thirty feet of the ship's bottom at the stem was out of water. Of course something more than air is needed to support a body weighing nearly 22,000 tons, which is about the displacement of the "Florida." The "Wyoming" and "Arkansas" class are several thousand tons heavier, while the new "Pennsylvania," now building, is a ship of 31,000 tons displacement.

I cast about for something with which all civilians are familiar to illustrate the severe motion of the ship and the experience through which the ships passed. Just enter one of the fast elevators which shoot from the basement of a skyscraper to the roof in such incredibly short time. Let the elevator drop suddenly for thirty feet. The floor seems to fall out from under the feet of the passenger and he feels almost light enough to fly. Let the elevator pause and one feels as though he were going through the floor, and just as the thought flashes through his mind that he's glad the drop is over, down goes the elevator again, with lightning-like rapidity, for fifteen or twenty feet. It stops with a convulsive shudder and then starts upward again with a jerk. About this time, to get the whole effect, someone should pour a torrent of water down the elevator shaft. Repeat this performance, and add to it a deafening noise so that conversation is impossible, five times a minute for 24 hours, and you have a suggestion of what the ships of the Atlantic battleship fleet went through.

Plunging through such a sea was the acid test of the seaworthiness of the dreadnought type, and the United States can now feel assured that the dreadnoughts can steam at their standard speeds through any sort of weather.

Even in the roughest part of the storm

the battleship "Florida" would have been able to go into action. The forward turrets were awash, but the three after turrets could have been used with a fair degree of success against an enemy several miles away. It has long been contended that a naval battle could not be fought in very rough weather. I believe that this contention has been disproved, for during the worst of the blow the guns of the "Florida" were trained on the flagship "Wyoming," five miles on the port beam, and two of the pointers told me that they had no difficulty whatsoever in keeping on the target.

A number of defects in the construction of the great dreadnoughts seems to have occurred; this is not a one-man opinion, but the consensus of opinion of the naval officers in the Atlantic fleet.

The gravest defect is the placing of the secondary battery of five-inch guns, which are supposed to be used for torpedo defense; that is, to drive off torpedo boats. The guns on the "Florida" type of ship are on the gun deck and but fifteen feet above the water. Gun ports, a part of the sides of the ship, must be opened if the guns are to be used.

Even in moderate weather these gun ports may be opened only at the grave risk of flooding the various compartments of the ship. This, of course, would short-circuit the electrical apparatus and render the guns hopelessly useless.

Torpedo destroyers are being built larger and larger. There is hardly any ordinary gale that hinders their operation. Certainly there were many days and nights when the five-inch guns of the "Florida" could not have been used, although the weather was mild enough to permit destroyers to operate with a reasonable probability of success. It would be under these conditions that a clever strategist would send in his destroyers to torpedo an enemy's fleet. The only defense that the "Florida" type would have, would be the great 12-inch guns.

Either these guns of the secondary battery should be placed on a higher deck or should be removed entirely, thus reducing the tonnage by many hundreds of tons. The ordnance experts state that if the secondary battery is placed on a higher deck where it can operate in any sea in which a destroyer can operate, the center of gravity of the ship will be disturbed and that the guns would have to do without armor. Armor may or may not be of great importance for the protection of the secondary battery; but as it is placed now, the secondary battery, under heavy weather conditions, is practically useless for the purpose for which it is intended. The larger the destroyers become (and they are growing in tonnage each year by leaps and bounds) the more useless becomes the secondary battery; for, the larger the destroyer, the greater the seaway in which she can operate.

Considerable difficulty has been experienced in lashing the anchors for sea. The bill-board type of anchor has been abandoned, and on the dreadnoughts the anchor chain is drawn taut by the anchor engine and is secured. The anchor itself is not lashed by chains and ropes with the result that sometimes it works loose and in a heavy sea will batter the ship's side unmercifully. The anchor of the "Florida," which weighed several tons, worked loose during the gale, and, with every heave of the ship, would batter the hawse pipe.

The experiment of placing the officers' quarters forward under the forecastle is condemned by nearly every officer in the fleet. The motion is so severe that they cannot do the work which must be done in their rooms, and, when at sea, the wardroom, cut off from the rest of the ship, is so stuffy and uncomfortable as to be unbearable.

On the "Florida" there were two five-inch guns in the wardroom. It was impossible to tightly close the gun ports, with the result that several times the officers dined with an inch or two of water on the deck.

On the whole, the dreadnought type of ship has shown its absolute superiority over all other classes of craft for main line-of-battle position. The motion was severe; but at no time would it have been impossible to go into action at five minutes notice. The ability of the ships to maintain a standard speed through any kind of weather will, of course, have an important bearing on any naval actions into which the dreadnought type may be ordered. It is probable that in the dreadnoughts to be built in the future some change will be made in the disposition of the secondary battery; but it is certain that so far as the general design is concerned the type will be standard for many years to come. As to the lines of the ship and the great tonnage found in the newer dreadnoughts, no change will be made until great strides have been accomplishd in the art of marine construction; for the type is as nearly perfect as possible.

**The Symons Gold Medal** of the Royal Meteorological Society awarded every two years, and alternately to a British and a foreign meteorologist, will be presented at the annual meeting of the Society next January to Mr. W. H. Dines, F.R.S., the leading English student of the upper air.

# Correspondence

*[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]*

## The Most Needed Invention

To the Editor of the Scientific American:

The most needed invention, the writer believes, is a means of harnessing electricity in its transit from heaven to earth in sufficient quantities to be of practical use for power, heat, and light. Benjamin Franklin, before we were born, harnessed a sufficient quantity of it to produce a spark, and it seems that all of our inventors since then have failed to do more in that line.

The writer believes this as sure to come as that we have the telephone and wireless telegraph and aeroplane. Wonders never cease. It is as it were but a fortnight since the idea of an aeronaut flying head down, looping the loop, and even defying the skill of the birds, who have been supreme in the air all the past centuries. Let the minds of our inventors center upon the harnessing of the boundless electric forces and see how soon advancement will be recorded.

Indianapolis, Ind. J. A. McAnulty.

## Student Labor and Public Works

To the Editor of the Scientific American:

I noticed in the Scientific American for December 6th a short article on student labor on public works. The Dickinson County High School has been employing students in various occupations for the past two years. The high school has a farm and a school garden. A part of the labor on these has been performed by students. The mechanics department of the institution makes hay racks, water troughs, feed troughs, singletrees, doubletrees, neck yokes, wagon tongues, etc., for the farmers of the surrounding country. It also repaired last year two gasoline engines. A new shop for iron work is now nearing completion. All of the wood work, including the making of the window frames, doors, roofing, etc., has been done by student labor. The cement floor and walks will also be put in by students. W. S. Robb.

Chapman, Kans.

## A Comparison of Battleships

To the Editor of the Scientific American:

Your article in the Scientific American Supplement of November 22nd comparing so-called contemporary British and American battleships is a little unfair to British designers and not up to the usual Scientific American standard of accuracy. As the British and American fleets can never, by any conceivable circumstances, be arrayed except on the same side, I think you will agree that the facts can be discussed and compared openly and without fear, and I hope you will allow me briefly to refer to the matter. You compare the "Nevada" and "Orion," but I cannot imagine how you can consider this a fair comparison seeing that the "Orion" was actually afloat in 1910 and completed in 1911, while the "Nevada" will not be ready until 1915.

I presume you select the "Nevada" as being as powerful a battleship as you have launched; and if you wish for a contemporary British ship of the same date and most powerful type, you will find her in the "Queen Elizabeth."

These two fine ships compare as follows:

| | "Nevada." | "Queen Elizabeth." |
|---|---|---|
| Date of launch | 1913 | 1913 |
| Date of completion | 1915 | 1914 |
| Tonnage | 27,500 | 27,500 |
| Thickness of armor belt | 13½ in. | 13½ in. |
| Designed speed | 20½ knots | 25 knots |
| Armament | 10—14 in.<br>21— 5 in. | 8—15 in.<br>16— 6 in. |
| Weight of broadside | 14,000 lbs. | 15,600 lbs. |
| Fire direct ahead or astern | 7,000 lbs. | 7,800 lbs. |
| Torpedo tubes | 4 | 5 |

Of these two boats launched at the same time, of identically the same tonnage, the "Queen Elizabeth" is inferior in no particular and decidedly superior in many. H. Allan Morgan.

Holmwood, Knutsford, Cheshire, England.

## The Velocity of Wireless Waves

To the Editor of the Scientific American:

The scheme for measuring the velocity of wireless waves proposed by Mr. Riggs in your issue of November 15th, strikes me as very interesting and ingenious, but I think that the problem is even simpler than he indicates. His proposal is that clocks at the Paris and Arlington stations should send out signals each second and that these should be received on chronographic recorders. Why not have the signal sent from one end and echoed back from the other as soon as convenient afterward, with the record made at each end of the time elapsed between sending and receiving? Thus, suppose the Paris operator sends first and the Washington station answers within half a second. The return would be received at Paris after an interval equal to the delay at the other end plus twice the time required for the travel of the wave.

It is possible to anticipate approximately the determination of the time of transit. Hertzian waves are undulations of the same ether which carries the radiations of light and heat. The speed of the latter waves has been measured many times with considerable accuracy, and is close to 186,000 miles per second. Radiant heat, light of various colors and the invisible ultra-violet radiation differ among themselves only in wavelength. The speed is the same for all, and all are of the same type, namely, transverse vibrations like those on the surface of water. It appears that wireless waves are of exactly the same kind, but thousands of times longer than the minute fractions of an inch which measure the length of light and heat waves.

From Paris to Washington it is approximately 4,000 miles. At 186,000 miles per second, this means that the signal will reach Washington about 0.022 second after leaving Paris.

For recording intervals of time so short as this with accuracy worthy of the opportunity, the ordinary chronograph would seem hardly suitable. It occurs to me that a photographic appliance might be devised to do the work a great deal better. Some such arrangement, for example, as this: A circular sensitive plate rotated at high speed in a light-tight case containing a small window which gradually travels radially. A weak constant light traces through the window a spiral line on the plate. The receiver of the wireless wave actuates a small mirror which throws an intense beam of light across the window at every vibration, but normally the beam strikes the case at one side of the opening. The same instrument might act to record the sending of the signal, or the light of the spark itself coming through the window could make the mark. Then, knowing the speed of rotation of the plate, or having photographic marks made at suitable intervals of time along the spiral, the determination of the lapse of time would be easy.

A weak impulse which had traveled 4,000 miles should be much more positive in its action upon some such delicate apparatus as that needed to deflect a tiny mirror than upon a machine which could make a mechanical mark upon a paper record. The device to actuate the mirror might be some sort of D'Arsonval galvanometer, or perhaps even a telephone receiver with the mirror glued to the diaphragm.

Berkeley, Cal. Howard H. Bliss.

## Lunar Rainbow

To the Editor of the Scientific American:

Have noticed your recent articles on lunar rainbows and rainbows seen after sunset, and it occurred to me that you might be interested in a report of a lunar rainbow observed by the writer on the night of September 13th, 1913, at 9:15 P. M.

This was observed from a Vermont Central train while running between Mount Hermon and Northfield, Mass. There was a bright moon high in the sky, and nearly full at the time. Tiny needle points of rain showed on the panes, and the rainbow was observed on the west side of the track, apparently about five hundred feet distance. The most striking features were that the southern end of the bow rested upon the pasture, while the northern end rested upon the tops of a group of trees apparently sheltering a cemetery. All the colors of the usual rainbow seemed to be present, except they were of a lighter shade.

This same bow was observed by Mr. F. H. Whitcomb of New London, Conn. James W. Aughiltru.

New York city.

## The Remarkable Long Distance Flight of Védrines

The Paris to Cairo flight places Pierre Jules Védrines at the head of long-distance aviators. Rodgers's 4,000-mile journey from Sheepshead Bay to San Francisco in 1912 and Brindejonc des Moulinais's Paris-Warsaw-St. Petersburg-Paris round of 3,000 miles this year were easy flights in comparison.

Rodgers and Brindejonc des Moulinais flew over civilized lands. Védrines made himself subject to arrest in Germany by going outside the prescribed lane, was fired on in Servia; crossed the battlefields of Thrace; and traversed mountains 16,000 feet high on his way from Constantinople.

# Communication Between Aircraft and the Ground*

## Adapting Wireless to the Requirements of Military Aircraft

By Major H. Bannerman-Phillips

RECONNAISSANCE by aircraft has now become an established and recognized necessity in military operations of any magnitude, and if thus far of supplementary value only for warfare at sea, it is nevertheless of such importance that every nation which aspires to be a naval power finds it necessary to study the subject.

It is impossible to say how far aircraft will be useful for purpose of aggression, but at present they are to be reckoned upon only for obtaining information. How to convey that information to headquarters with the least possible loss of time is frequently of as much importance as how to procure it. Aircraft travel such distances on reconnaissance that visual signaling is often impracticable, besides being liable to be read by the enemy, and at short distances it is quicker to drop written messages at pre-arranged spots or to return and report in person.

It is of course feasible for the observer who is responsible for the results of the reconnaissance to descend from an airship by means of a parachute at a given point, say near the headquarters staff in the field, the vessel which carried him being then free to proceed to the air service camp to refit, without loss of time. Major Maitland, an officer of the British Royal Flying Corps, proved this on October 18th last by dropping from the airship "Delta" in a parachute by way of experiment when at an altitude of about 2,000 feet with complete success. He had dropped from a balloon on a previous occasion, in similar fashion.

### The Possibilities of Wireless.

Wireless telegraphy therefore is the best method of sending messages, although it is open to the objection that its use may betray the presence of the scouting aircraft to the enemy, especially at night, when it might otherwise escape notice in the case of an airship. The weight of the apparatus is another matter which is a disadvantage and which practically reduces its use on aeroplanes to comparatively short distances. Then again since wireless messages are liable to be picked up and read by the enemy, it will usually be advisable to send them in cipher. This involves loss of time spent in de-coding them, and time is nearly always precious when there is a question of conveying information, as already pointed out. Therefore it may be simpler, quicker and altogether more satisfactory, especially in the case of an aeroplane, to return to headquarters with the results of a reconnaissance, than to code and send it and have it de-coded at the ground receiving station, whence it may have to be again sent on by messenger or signal to headquarters.

Even in the case of code messages, the enemy may possess officers skilled in cryptography who will be able in a reasonable time to discover the code and read them.

The aeroplane in its present state of development is at a considerable disadvantage as compared with the dirigible in regard to the use of wireless telegraphy. The continuous vibration and noise of engines and propeller render it impossible to receive any message whatever,† and unless it carries an observer as well as a pilot, the sending of anything more than the very simplest report would be out of the question. Considerations of weight and aerial militate against sending farther than about thirty miles, and if it is considered necessary to carry an observer, oil and fuel for long-distance flight, camera and possibly an automatic rifle and supply of ammunition for defensive purposes, the additional weight of wireless apparatus will become a very serious consideration. It would be also a doubtful advantage in view of the time to be taken in sending messages by code when a return can be made at 50 or 60 miles an hour for the purpose of reporting direct to headquarters.

With the airship or at any rate with the large weight-carrying airships, the case is reversed. To begin with, messages can be sent up to 200 miles, either to a permanent coast or other station, or to a cart-station such as those of the Marconi Wireless Telegraph Company, specially designed for military work. It is quite feasible to stop the engines for a time in order to receive instructions on the subject of the reconnaissance in answer to reports sent. According to present rates of speed an airship could cover the 200 miles of the outward journey in four to five hours, and after hovering or sailing slowly for an hour or so over the area to be reconnoitered (while simultaneous notes were made by different observers and photographs taken), could return in another four or five hours with the negatives developed and ready to supplement the reports. In the meanwhile these latter would be sent on ahead by wireless at once, and corroboration, personal explanation and answer to questions concerning details would follow on arrival at headquarters.

### Flashes and Their Utility.

Methods of visual signaling between aircraft and aircraft in mid-air or between aircraft and the ground, include flashing lamps at night from either aeroplanes or airships, and semaphore from the latter by day. Written messages can be dropped by parachute. Where it is inadvisable to return and report, direct wireless telegraphy is by far the best of all methods of communication. Any wireless system which can be worked on land answers practically as well in mid-air, though of course the weight to be carried is a very important consideration and makes certain systems unsuitable.

The British Air Service has its own system, and the Rouget is also much used. A satisfactory aerial for aircraft is the trailing wire which can be kept rolled upon a drum and unrolled and rolled up again when not in use. A safety catch can be arranged in connection with this form of aerial, so that if by accident it should become entangled in anything during flight, the pull would release it and thus obviate damage.*

With regard to portable ground stations to be used in communications by wireless with aircraft, it would take too long to compare the merits of different systems. It must suffice to give a short description without too many details, of some of the best known—those of the Marconi Company, who have made a special study of the type. The largest of these stations has a range of about 200 miles. It is designed for wheel transport, the time required to erect or dismantle is 20 minutes with 8 men; 3 men could do the work, but it would take longer, naturally. The weight of the station alone is about 784 pounds. For transport it is normally divided into two horse-drawn units, or the whole can be conveyed as one unit, if self-propelled. In the former case the limbered wagon type of vehicle has been adopted. The first limber carries the generating plant and the wagon carries the transmitting and receiving apparatus; the second limber carries a supply of gasoline and spare parts, and the wagon carries the masts with all their gear, as well as the aerial and earth wires. The prime mover of the station consists of a 2-cylinder gasoline engine having an output of about 8 horse-power. It runs at a speed of 2,000 revolutions per minute, and is air-cooled by a special blower mounted on the fly-wheel, which keeps a continual blast of air circulating round the cylinders.

The engine is direct coupled on an aluminium bed-plate to a self-exciting alternator having an output of about 2 kilowatts. Mounted on the shaft of this alternator at the end remote from the engine is the disk discharger, the function of the latter being to break up the train of waves into groups of waves so as to give the sound produced in the receivers a musical note. The current from the generator is carried by a flexible cable to the instrument cart, where it passes through the manipulating key to the transformer. Here it is transformed to a high voltage current which charges the battery of condensers in the primary high-frequency circuit. These condensers discharge themselves through the disk discharger (already mentioned) and through the primary of the high-frequency transformer, the secondary of this high-frequency transformer being connected to the aerial on one side and to the earth on the other side.

Both the primary and the secondary circuits of this high-frequency transformer are connected through suitable inductances for changing the wave-length, and through the change-time switch, by means of which the operator is able to change his wave-length at will. The receiving apparatus is also carried in this cart and consists of 2 separate receivers, one receiver being specially adapted for the change-time switch, and the other receiver being of a more simple type and arranged for tuning up quickly to any wave-length between 500 and 1,400 meters.

The antenna consists of 2 woven wires about 500 feet long, which are supported by 2 masts 70 feet high. These masts are carried in sections and erected by means of a derrick built up of 2 mast-sections.

When it is necessary for a mobile wireless telegraph station to be carried by pack transport the engine and dynamo are mounted on either side of a rigid pack-saddle frame adjustable to suit different sized animals. The saddle frame acts as a bed-plate for the generating set, and to remove the saddle from the back of a horse and get the station into operation takes only one minute. This type of saddle is used to carry all the four loads of the "Cavalry Station," which can move at a gallop, if required.

An even lighter station, but with a range of only 10 miles, called the "Knapsack" station, can be transported by 4 men, who each carry a load of 20 to 30 pounds, strapped to their backs. This would be useful in connection with aircraft principally in mountainous country.

* The cover design of this week's issue of the SCIENTIFIC AMERICAN represents a type of portable, wireless apparatus which has been designed by Mr. William Dubilier of New York for use on aeroplanes, and which has proven itself remarkably efficient in tests conducted at Aldershot last autumn by British army officers. The apparatus overcomes the principal objections mentioned in Major Bannerman-Phillips article. For the benefit of those familiar with wireless it may be stated that in Mr. Dubilier's apparatus sine waves of a musical frequency are produced for the first time from continuous current without the use of a rotary converter. An apparatus of 250 watts capacity weighs only 20 pounds complete for transmitting, without the generator, which itself is not larger than an ordinary fan motor and weighs 16 pounds. The principle of operation depends on obtaining a series of unidirectional impulses by a condenser discharge, pulsating currents following one another at regular intervals at a frequency of 500 per second. These impulses are produced from a primary direct current. It is possible to produce any frequency up to 1,000, the apparatus weighing complete not over 40 pounds and having an over-water range of about 250 miles on shipboard. An instrument weighing 15 pounds and occupying a space of less than one third of a cubic foot transmitted signals 20 miles to a portable aerial in tests conducted by the British government.—EDITOR.

† It has been shown possible to receive signals visually by causing a lamp to fluctuate. This would obviate the difficulty interposed by vibration.—EDITOR.

* Our cover design shows how the aerial may be disposed on the wings.—EDITOR.

## The Lobster and Its Eggs

THE way in which the lobster carries out its transformations from the egg to the adult stage has been most obscure up to the present time, but the problem may now be said to be solved by the researches made by Prof. Bouvier of the Paris Natural History Museum. These he carried out at the Plymouth maritime laboratory which is well fitted out for the purpose; the character of the coast is such that the lobsters are abundant among the rocks surrounding the lighthouse and they tend to remain at this place. After hatching, the young have an entirely different form from what we know, and in the larval state they are quite transparent. The body has three pairs of swimmers and is flat like a leaf, hence the name "phyllosoma" which is given them. Of very minute size, they live entirely in the water. No less than nine stages of transformation are observed between the larva and the perfect state, but the larva could not be cultivated up to the present. On the other hand, there were a few rare specimens found of what is known as "puerulus," considered by some as one stage in the evolution, but this was not certain. Prof. Bouvier now proves this to be a fact, and it represents the lobster at the time when it ceases to swim and takes up its lodging in the rocks. At this time it is about an inch long and quite transparent, with a rather soft shell. As it is hard to see or to capture, but few specimens exist at Paris, London, and others places. However, a fortunate catch at Plymouth brought up a "puerulus" which was being transformed into a lobster, so that the proof is now complete. It is stated that the time for the evolution from hatching of the larva up to the perfect lobster form is only two months.

## Substitutes for Celluloid

THE increasing use of celluloid for the manufacture of imitation ivory, horn, shell, linen, wood, glass, porcelain, etc., is due to the cheapness of this mixture of pyroxylin and camphor. It has, however, the serious drawback of being highly inflammable, and even explosive at high temperatures.

Hence substitutes lacking this dangerous property have long been sought. Such a one is acetyl-cellulose, made by the action of acetic acid on pure cellulose. This, however, is more costly, and therefore has not made its way except where price is a secondary consideration.

Very recently, however, substitutes have been invented which are not only effective, but cheap. These are *viscose* and *formyl-cellulose*, already known because of their employment in making artificial silk.

While they are not as yet utilizable for objects which must have great solidity like those of horn and ivory, it is safe to predict a great future for them, since already blocks of *viscoid* have been produced which can be readily colored, polished, and worked.

# Morning and Evening Stars for 1914

## A Transit of Mercury

By Frederic R. Honey, Trinity College

THE purpose of this annual paper is to show how morning and evening stars may be determined by inspection of the accompanying plot, and at the same time to exhibit graphically the principal elements of the solar system, to the end that the reader may familiarize himself with the relative positions of all the planets at any time during the year. Anything beyond a general inclusion of the asteroids has been avoided, inasmuch as these eight hundred little bodies occupying the space between Mars and Jupiter, would require a separate article for extensive treatment.

The year 1914 includes in its record the interesting departure from the usual, in a transit of Mercury which occurs in November of this year, when a tiny speck representing a planet 3,000 miles in diameter will traverse a chord of the Sun's disk, accomplishing the journey in a little over four hours.

**The Sun.**

The Sun, which controls the motions of the planets, is a self-luminous globe whose diameter is 864,367 miles, or a little over one and eight tenths the diameter of the moon's orbit. Its volume is 1,300,000 times the Earth's volume. The Sun rotates on its axis, which is inclined to the ecliptic, in about twenty-five and a quarter days, and in the same direction as the revolution of the planets in their orbits, as illustrated by the arrows *A* in the plots of the orbits of the major and terrestrial planets. The Sun's apparent diameter, which subtends an angle of a little over ½ degree, varies, slightly during the year. It subtends a maximum angle when the Earth is at perihelion in January; and a minimum angle when the earth is at aphelion in July.

**The Terrestrial Planets.**

The planets revolve around the Sun in the same direction in elliptic orbits, with the Sun at one focus, conforming to Kepler's first law of planetary motion. The orbital planes are inclined at small angles to the ecliptic, which is the plane of the Earth's orbit; and the intersection of each plane with that of the ecliptic is called the line of nodes. This line passes through the Sun, and in order to avoid confusion it is drawn only in the plot of Mercury's orbit. A part of this line is shown, however, in each of the plots of the orbits of all the planets at *N* and *N'*, where the planet passes from one side of the ecliptic to the other. If this page be placed in a horizontal position, it may be regarded as the plane of the ecliptic; and for convenience of reference it is conceived to divide space into two parts, viz., that which is below and above the ecliptic. *N* is called the ascending node, and *N'* the descending node; perihelion, or point of nearest approach to the Sun, is at *P*. The planets are divided into two groups of four, the terrestrial and major planets; the orbits of the latter are drawn to a scale which is very much reduced; and the great difference between the scales will be apparent on comparing the orbits of the Earth and Mars in the two plots.

**The Earth.**

Our planet, which may be regarded as a moving observatory, revolves around the Sun in 365¼ days at a mean distance of 92,894,767 miles, and at a mean velocity in its orbit of 18½ miles per second. The axis of the Earth is inclined to the plane of the ecliptic at an angle of about 66½ degrees, and the Earth rotates uniformly in a sidereal day, which is nearly four minutes shorter than a mean solar day, in the direction of the arrows (see position for January 1st). The center of the orbit is at *a*, which is at a distance of a little over 1,500,000 miles from the Sun (= *e*, the eccentricity). At the perihelion passage in January the Earth is therefore more than 3,000,000 miles nearer the Sun than it is at aphelion in July. The positions of the Earth and of all the terrestrial planets are shown at intervals of four days.

**Mercury.**

The great velocity and variability of the planet's motion, by which the perihelion and aphelion passages are made respectively at the rates of 35 and 23 miles per second, are due to the close proximity of Mercury to the Sun, and to the eccentricity of its orbit, which is greater than that of the orbits of any of the terrestrial or major planets. Mercury's mean distance from the Sun, expressed in terms of the Earth's distance, is 0.3871; and the eccentricity, bringing the center of the orbit to *b*, is a little over one fifth. In representing it on the plane of the ecliptic its true form is obviously distorted, but the deviation is scarcely apparent in the plot. The maximum angle which a radius vector forms with the plane of the ecliptic is 7 degrees, the inclination of the planet's orbit, and since the projection of a line on a plane is equal to its true length multiplied by the cosine of the angle which the line forms with the plane, the maximum diminution in the present case is less than one hundredth of its length ($\cos 7\text{ deg.} = 0.9925$).

The planet's period is very nearly 88 days (87.97 days) and its position is shown at intervals of two days. Kepler's second law, the radius vector sweeps out equal areas in equal times, is illustrated. For example, taking the Sun's center as the common vertex of two triangles whose bases, representing equal periods of time, are respectively that part of the orbit between the dates September 6th and September 14th, and that part between the dates October 24th and November, 1st, the areas of these triangles are equal.

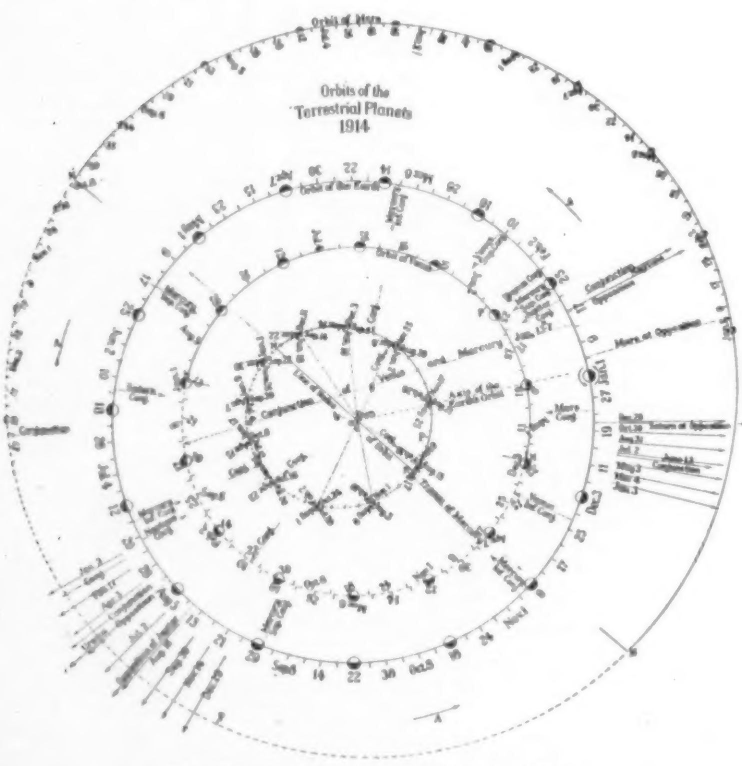
Since Mercury's orbit is inclined at a greater angle than that of any of the terrestrial or major planets, it is clear that the projections of the orbits of the other planets in both plots do not differ appreciably from their true form.

**Venus.**

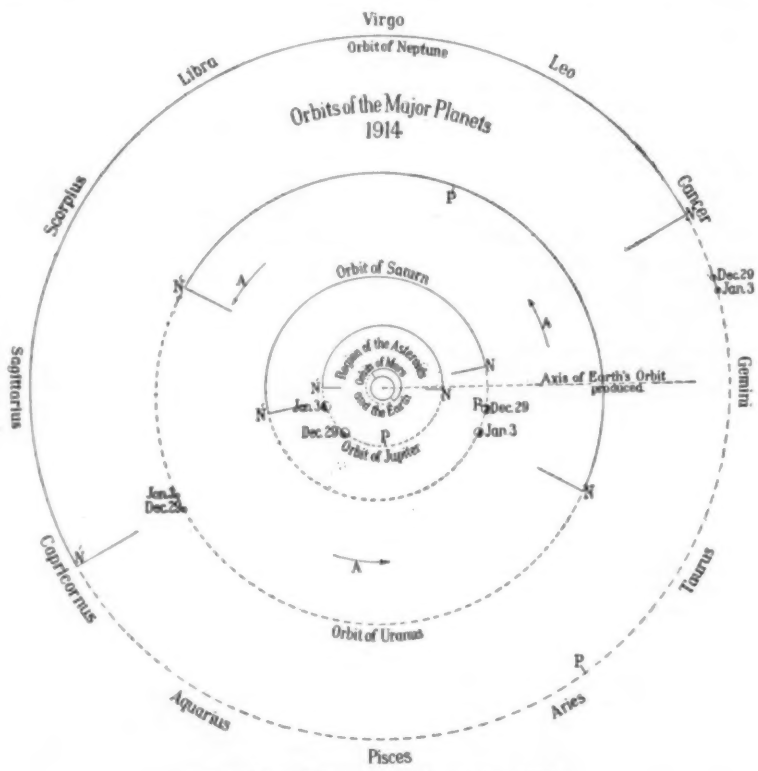
On account of the small eccentricity which is scarcely visible in the plot, the orbit of Venus differs very little from a circle, and the motion of the planet is nearly uniform at the rate of 21.9 miles per second. The orbital plane is inclined at an angle which is a little less than one half that of Mercury. The planet's distance from the Sun, in terms of the Earth's mean distance, is 0.723; and the period of revolution is 224.7 days. Thus Venus makes more than one and a half revolutions during the year. On August 13th the planet returns to a point on the orbit which is very near the position of January 1st, a distance traversed in seven tenths of a day. The dates until August 5th are attached without the orbit; for the rest of the year they are shown within the orbit.

**Mars.**

The plane of the orbit of Mars is inclined at an angle of only 1.85 degrees. While the eccentricity is less than that of Mercury's orbit, its linear eccentricity, or actual distance from the Sun to the center *c*, which is nearly one tenth the mean distance, is much greater than the corresponding measurement on the axis of Mercury's orbit. The mean velocity is 15 miles per second; the mean distance from the Sun is 1.5237 times the Earth's distance; and the period of revolution is 1.88 years.




The orbits of the terrestrial planets for 1914.




The orbits of the major planets for 1914.

**The Major Planets.**

The following table gives some of the elements of the orbits of the major planets. The mean distances are given in terms of the Earth's mean distance.

| Planet. | Mean Distance. | Period Years. | Velocity miles per Second. | Eccentricity. | Inclination to Ecliptic. |
|---|---|---|---|---|---|
| Jupiter.... | 5.20 | 11.86 | 8.1 | 0.048 | 1.31° |
| Saturn.... | 9.54 | 29.46 | 6.0 | 0.056 | 2.49° |
| Uranus.... | 19.19 | 84.02 | 4.2 | 0.047 | 0.77° |
| Neptune.... | 30.07 | 164.79 | 3.4 | 0.009 | 1.78° |

In the plot of the orbits of the terrestrial planets, the positions of Jupiter as seen from the Sun, are indicated by arrows at intervals of forty-five days; and Saturn's positions at intervals of sixty days. The positions of Uranus and Neptune are given at the dates of conjunction and opposition. In the plot of the orbits of the major planets, the positions are shown for January 3rd and December 29th.

**Conjunctions and Oppositions.**

In the plot of the orbits of the terrestrial planets, the positions are given for Greenwich noon, i. e., at the beginning of the astronomical day. It should be noted that the hour of the day when a conjunction or an opposition occurs, is shown by the measurement on the orbit; and that Washington time differs from Greenwich time by a little over five hours.

TABLE GREENWICH TIME.

| Date. | | Conjunctions. | Oppositions. |
|---|---|---|---|
| Jan. | 5 | | Mars |
| " | 17 | | Neptune |
| " | 20 | Jupiter | |
| " | 24 | Mercury (sup.) | |
| " | 27 | Uranus | |
| Feb. | 11 | Venus (sup.) | |
| Mar. | 10 | Mercury (inf.) | |
| May | 16 | Mercury (sup.) | |
| June | 13 | Saturn | |
| July | 16 | Mercury (inf.) | |
| " | 21 | Neptune | |
| Aug. | 2 | | Uranus |
| " | 10 | | Jupiter |
| " | 30 | Mercury (sup.) | |
| Nov. | 7 | Mercury (inf.) | |
| " | 27 | Venus (inf.) | |
| Dec. | 21 | | Saturn |
| " | 23 | Mars | |

**Conjunctions of the Planets.**

The first conjunction in the year, that of Mercury and Venus, January 13th, is the only one which is illustrated in the plot. The reader will easily discover a conjunction, by an inspection of the plot which shows the positions of the Earth and of the planets at the date given in the table.

CONJUNCTIONS OF THE PLANETS.

| Date. | | Planets. | Date. | | Planets. |
|---|---|---|---|---|---|
| Jan. | 13 | Mercury and Venus | June | 16 | Venus and Neptune |
| " | 22 | Mercury and Jupiter | " | 25 | Mercury and Neptune |
| " | 25 | Venus and Jupiter | July | 7 | Mercury and Neptune |
| " | 26 | Mercury and Uranus | Aug. | 5 | Venus and Mars |
| " | 30 | Venus and Uranus | " | 9 | Mercury and Neptune |
| Mar. | 3 | Jupiter and Uranus | Oct. | 5 | Mercury and Mars |
| " | 6 | Mercury and Venus | " | 30 | Mercury and Mars |
| Apr. | 20 | Mars and Neptune | Nov. | 21 | Venus and Mars |
| May | 16 | Venus and Saturn | Dec. | 7 | Mercury and Venus |
| " | 28 | Mercury and Saturn | | | |

**A Transit of Mercury.**

A transit of Mercury across the Sun's disk can occur only in the month of May or November, and when the planet is near one of the nodes of the orbit. If the line of the nodes be produced in both directions, it will be seen that it intersects the Earth's orbit at points which our planet reaches early in these months. On account of the great eccentricity of Mercury's orbit, he comes very much nearer the Sun at the ascending node when he is approaching perihelion; and as a consequence November transits are far more frequent than those which occur in the month of May. The intervals of time between two consecutive November transits, may be either seven or thirteen years.

Mercury's period (nearly 88 days) expressed in a fraction of a year is 0.24085; and $\frac{7}{0.24085} = 29.06$; i. e., Mercury makes a very little over 29 revolutions in seven years. Thus one transit will follow another, seven years later, provided the planet is near enough to the node at the later date; and since during this period it makes a small fraction over 29 revolutions, the transit will occur earlier in the month. The date of the last transit was November 14th, 1907. The date this year will be November 7th. The planet will reach a point nearest the center of the Sun's disk a few minutes after noon Greenwich time. Owing to the difference of time between Greenwich and Washington, the transit will be observed at the latter place five hours earlier in the day, i. e., the Sun will rise with Mercury on its disk.

In thirteen years the planet makes very nearly fifty-four revolutions; thus $\frac{13}{0.24085} = 53.98$; i. e., one transit may succeed another, after an interval of thirteen years, provided Mercury is near enough to the node at the second date, in which event the transit occurs later in the month. Transits occur at consecutive intervals represented by the series 7, 13, 13, 13, 7, 13, 13, 13, 7, etc. The sum of any four consecutive periods is 46 years, which always includes one period of 7 and three of 13 years. Dividing 46 by Mercury's period we have $\frac{46}{0.24085} = 190.99$. Thus, it appears that after an interval of 46 years, and 191 revolutions of the planet, a transit occurs when the Earth and Mercury are near the same point in each orbit. The following dates when transits occurred, illustrate these intervals: November 4th, 1867; November 7th, 1881; November 10th, 1894; November 14th, 1907; November 7th, 1914. The first observation of a transit of Mercury was made in November, 1631; and it will be seen that this date belongs to the series; thus $1907 - 1631 = 276 = 46 \times 6$.

**How to Find Morning and Evening Stars.**

Morning and evening stars for any day in the year may be found by placing the plot of the terrestrial planets in a position where the date attached to the Earth may be read without turning the head. In this position a straight edge through the Earth and the Sun will divide the planets into two groups; those on the right which rise before the Sun, and which are therefore morning stars, and those on the left, which set after the Sun, and are evening stars. Between superior and inferior conjunction, Venus and Mercury are evening stars; and between inferior and superior conjunction, they are morning stars. Before conjunction a planet whose orbit is outside the Earth's orbit is evening star; after conjunction it is morning star. At the date of opposition, when a planet is above the horizon before and after midnight, it is both morning and evening star. The Earth rotates in the direction of the arrows (see position for January 1st). Between sun-set and sunrise, the observer is on that half of the Earth's surface which is in shadow. At sun-rise he emerges from it; and at sun-set he enters it. By an inspection of the plot it is a simple matter to determine the relative positions of the observer to the Sun and all the planets during the day or night, at any assigned date.

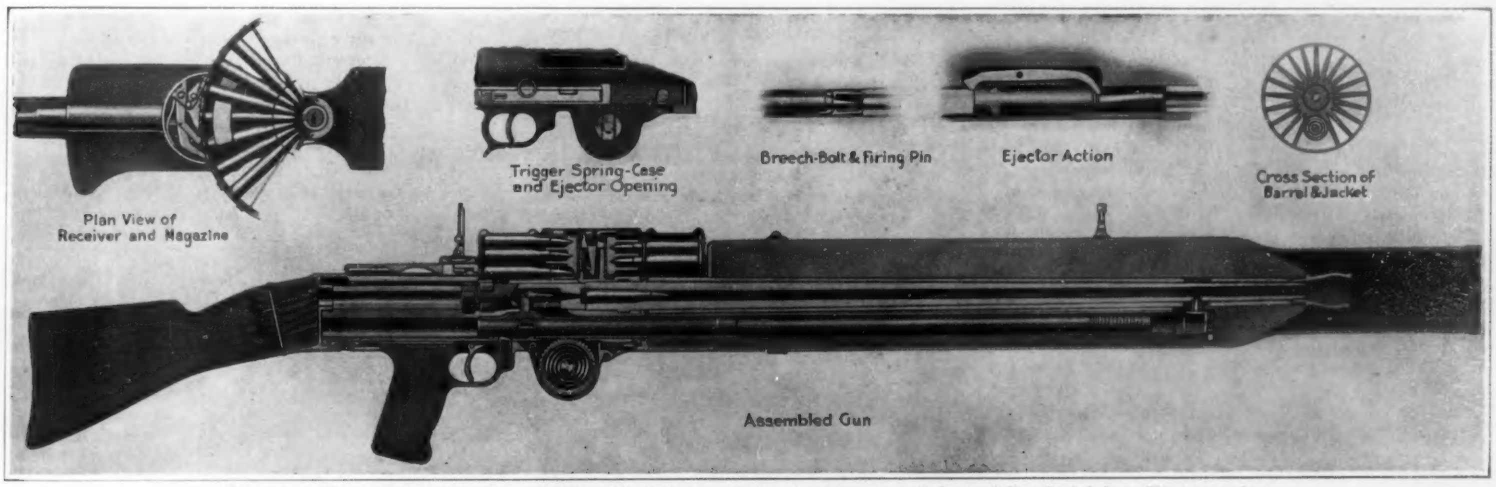
## The Lewis Air-cooled Machine Gun

WE present illustrations of an air-cooled machine gun, the invention of Col. I. N. Lewis, formerly of the United States Army, which has been undergoing firing trials successfully in Russia, Belgium, Italy, Austria, and Sweden, and is now being tested by a special board of officers of the United States Army. Col. Lewis is known to our readers as the inventor of the Lewis depression rangefinder, which is in service on the coast defense batteries of the United States seaboard.

Two problems of special difficulty confront the designer of an automatic gun timed to fire a large number of shots at high speed, namely, keeping the barrel cool, and feeding the loaded cartridges and ejecting same when empty. By studying the accompanying illustrations, it will be seen that the barrel is inclosed in a close-fitting jacket, made of aluminium and formed with a number of radiating longitudinal fins. Fitting closely over the outside edges of these is a light steel casing 3¾ inches in diameter. This extends beyond the forward end of the barrel. At each discharge the blast of gases from the muzzle acts as a kind of pump plunger and sucks currents of fresh air through the V-shaped channels surrounding the barrel. There is a passage of fresh cold air at each discharge, and this serves to cool the barrel without the use of water. Aluminium has six times the heat conductivity of steel, and the heat conveyed from the barrel to the aluminium fins is rapidly dissipated by the continuous passage of currents of air between them. The first few hundred rounds raises the temperature of the barrel to 330 deg. Fahr. Thereafter it rises more slowly, and after one thousand rounds have been fired it does not exceed 440 deg. Fahr. By varying the dimensions and form of the aluminium jacket, it is claimed that any desired limit of cooling may be secured.

Col. Lewis considers that the method employed for feeding the cartridges is an even more important improvement than the cooling device. In this design, the belts or long metal slips used in other guns of this character, are abolished, and in their place is a horizontal balanced rotary magazine, shown in part plan and in vertical section, in which the cartridges are placed radially, the magazine being attached upside down, over the breech opening, and held in place by a pivot stud on the receiver body. The operating spring is placed on the bottom of the gun, and is far enough removed from the barrel to avoid being affected by the heat of the barrel.

The energy required for loading, closing the breech, firing the cartridge and ejecting the empty case is obtained by diverting some of the gases of discharge through a small hole, drilled through the bottom of the barrel, a few inches from the muzzle. These gases act on a piston in a cylinder carried immediately beneath the barrel, the piston being at the front end of a long piston rod, the rear end of which is connected to the breech-operating mechanism. Col. Lewis describes the action as follows: When the gases act on the piston, the energy stored in the moving mass overcomes the resistance due to the work of unlocking the breech, extracting and ejecting the shell, turning the magazine to bring the next cartridge into place, and winding up the operating spring, which spring serves subsequently to close the breech and fire the shot. This complete series of operations may be completed at the rate of 800 times a minute; but the rapidity of fire can be regulated to a lower speed by adjusting the area of the hole through which the gases enter to act on the piston. The operating spring below the barrel at the breech is similar to that used in clocks, and it is mounted in a small oil- and dust-tight case in front of the trigger. The toothed periphery of the spring drum engages a toothed rack, formed on the underside of the piston operating rod. When the last is driven back by the gases, opening the breech and ejecting the spent cartridge, the spring is wound up by the action of the rack on the toothed periphery of the spring case. When the momentum of the rod has been expended in its backward travel, the spring comes into action, casting the rod back to its starting position, closing the breech and firing the charge. An additional advantage is that the friction set up by the gases impinging on the end of the tubular steel casing diminishes the force of the recoil one half. Hence, it is possible to fire the gun when holding it at arm's length—an advantage which makes it peculiarly fitted for use on aircraft. The weight of the gun is 26½ pounds.




This gun, weighing only 26½ pounds and firing 800 shots per minute at maximum speed, is specially adapted for military aeroplanes.

**Details of the Lewis air-cooled machine gun.**

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**The Canadian Arctic Expedition.**—Press dispatches from Nome, Alaska, state that the "Karluk," the principal vessel of Stefánsson's arctic expedition, succeeded in getting out of the unseasonably heavy ice that now blockades the Arctic shore of Alaska, and making winter quarters. The other three vessels of the expedition, the "Alaska," "Mary Sachs," and "Belvedere," are fast in the ice, and therefore are not likely to reach their proposed base in Victoria Land this season.

Three stages in the interesting process of forging a ring, under the steam hammer, for a bevel ring gear.

# Going Through the Shops—II

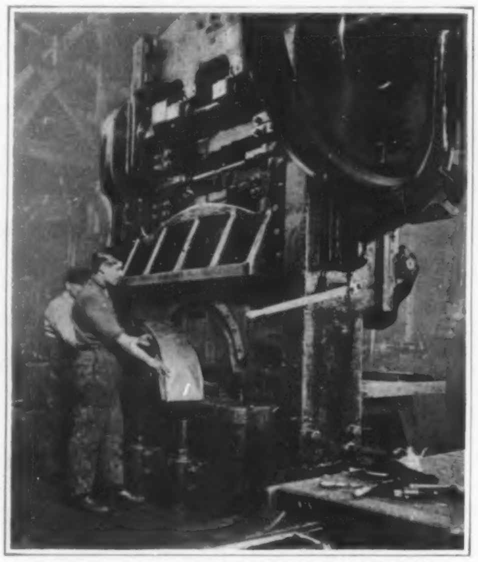
## Our Associate Editor Sees How the Automobile Industry Has Stimulated Machine Tool Manufacture

By A. Russell Bond

FROM tinsmith to electrician, from wheelwright to upholsterer, a score of trades contribute to the manufacture of an automobile. It is almost too much to expect all these operations to be carried on in a single factory. The majority of motor car companies are content with the building of the motor and a few accessories, while some do not even do that, but purchase all the parts, including the motor, and in their own shop merely assemble them into complete automobiles. This is true even of high grade machines, for the parts, although manufactured outside are made according to the company's own blue-prints and specifications and under the eyes of their own inspectors. However, there are a few companies who make practically every part of the automobile in their own works, from the foundry and forge shop to the wheel and body building plant.

In this article we shall not attempt to describe the complete manufacture of automobiles, nor even single out any one branch of the work for detailed description, but we shall present merely a few scattered notes on interesting processes and machines that are to be found in the motor car factory.

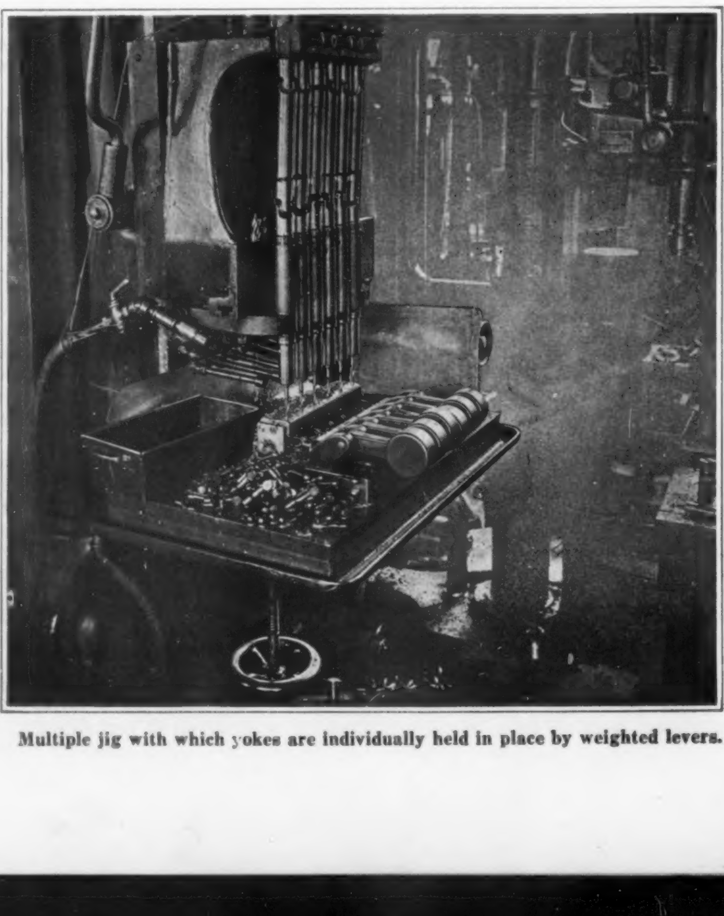
A visitor, particularly a layman who does not appreciate all the technical details of the machine shop, is sure to find the forge shop most entrancing; for man has not outgrown his primeval fascination for fire, and a sight of incandescent metal still throws a mesmeric spell over him. It is wonderful to watch the ponderous hammer of the drop forge, dancing over the work and periodically coming down with a light tap that deftly shapes the glowing metal or with a resounding crash as it cuts away superfluous parts. The intricate shapes that are turned out by these power hammers are marvelous. The three photographs at the top of this page show some interesting stages in the forging of a ring for a large bevel gear. A rectangular block of white-hot steel is taken out of the furnace and hammered in the forge until it takes the shape of a bulging body with rounded shanks at each end. The body is then flattened and placed over a die at one side of the anvil, where at the next blow a slot is all but cut through the middle of the body, so that it looks somewhat like a chain link, as shown in the first photograph. At the opposite side of the anvil there is a depression flanked by a semi-circular boss on which the link is rested. A similar semi-circular boss on the hammer head is intended to enter the depression, so that when it descends it strikes the link with a shearing motion, spreading it open into a ring, as shown in the other two illustrations. Of course, the process is more difficult, consumes more time, and is more expensive than casting the ring, but the result is much toughter steel, and, considering the use to which the part is to be put, it is well worth the additional cost.



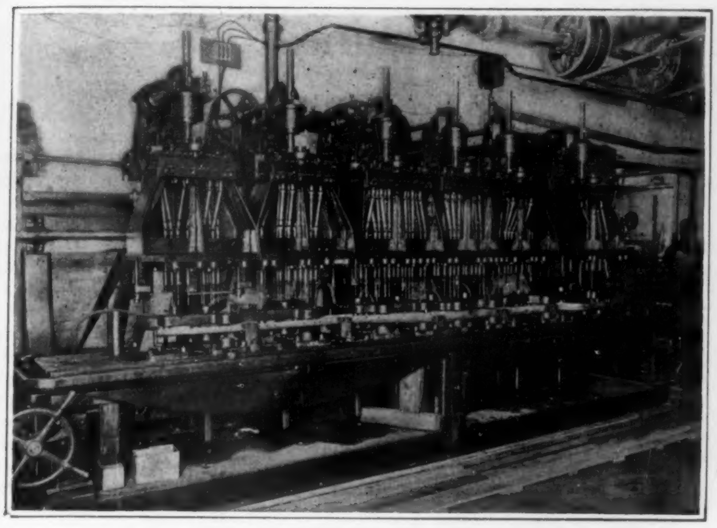
Mammoth press with which crowned fenders are formed.

Noisy as is the forge shop, it cannot compete in din and distracting confusion with the shop where sheet metal is hammered into various forms. Enormous steel presses cut out the fenders and body parts from sheet metal. One of our illustrations shows a large press stamping out a crowned fender. To this the side wings or aprons must be attached, and this is done by electric spot welding. Sheet aluminium is largely used in the building of the body. To bring this metal to the requisite contour it must be hammered. Some car

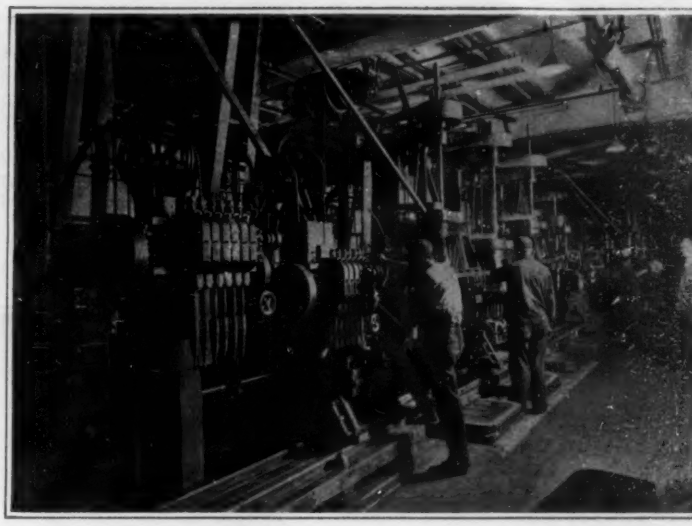
Milling two dozen spring hangers at one "set up."



Multiple jig with which yokes are individually held in place by weighted levers.



An enormous multiple drill operating on a frame side-bar.

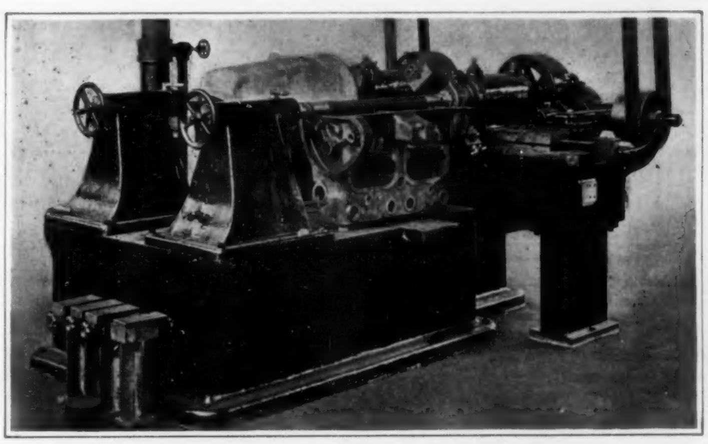


Battery of multiple drills which operate successively on a cylinder casting.

bodies are made of cast aluminium, instead of sheet metal secured to a wooden framing, and curiously enough the cast bodies are actually lighter than the sheet metal bodies, for the reason that they do not have to have as much bracing.

In the body plant one views with interest the application of paint to the metal parts by dipping, and also by spraying with an air brush. The latter operates like the artist's air brush. A stream of compressed air injects a fine spray of paint which may be laid on very evenly. Automobile manufacture is a young industry, but it has grown to be one of the biggest in the country, and has furnished a great stimulus to machine tool manufacture. In fact, it has grown so fast that the tool maker has had a struggle to keep pace with it. It is constantly demanding special machinery, not only to save hand labor, but to save machine labor; that is, multiple and gang machines which will co-operate to perform the work that previously required the use of a number of machines. It has developed new methods in setting up the work on the machine. It has produced jigs of most ingenious types to save time in setting up the work and to insure uniformity of product.

In last week's issue of the SCIENTIFIC AMERICAN we told of labor-saving methods employed in the manufacture of the low-priced car. This may have led some to believe that in the higher priced cars labor saving methods are not employed. Because the higher priced cars are usually turned out in smaller quantities, it does not pay to carry the labor saving methods to the extreme requisite in the manufacture of the low-priced cars. However, where a great many parts are to be duplicated, where a single casting is to have a great many holes bored in it, where a great many operations are to be carried on at the same time on a single piece of work, and where the various operations require simultaneous operation in order to obtain accuracy and uniformity, special jigs and machines are employed. One of our illustrations shows the milling of a large number of spring hangers. These are mounted on the machines in batches of two dozen, and four milling cutters operate on them at a time, so that the opposite faces of each arm of the fork are finished simultaneously, and they must bear the proper relation, one to the other. Another illustration shows a multiple jig, the feature of which is the automatic device that holds the steel forged yokes in place, to prevent them from springing while the arms of the yoke are being drilled. Before this device was invented, great difficulty was experienced in drilling the holes in the arms of the yokes, and keeping them in perfect alignment for the reason that the upper arm, being unsupported, would be sure to bend under the pressure of the drill. In this jig a division plate is placed between the two arms, and the yokes are held in position against a stop by means of weighted levers. The weights on the levers are shown in the foreground. Six yokes are drilled at a time, and by the use of this special jig 2,500 yokes may be turned out per day.

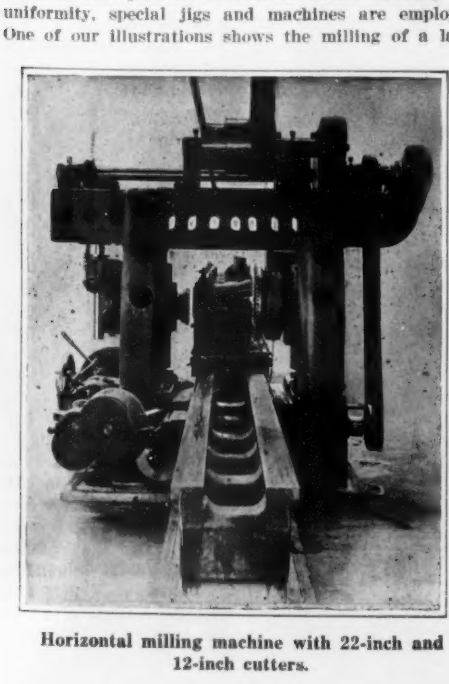


Special machine for recessing and facing a crank case and engine pan.

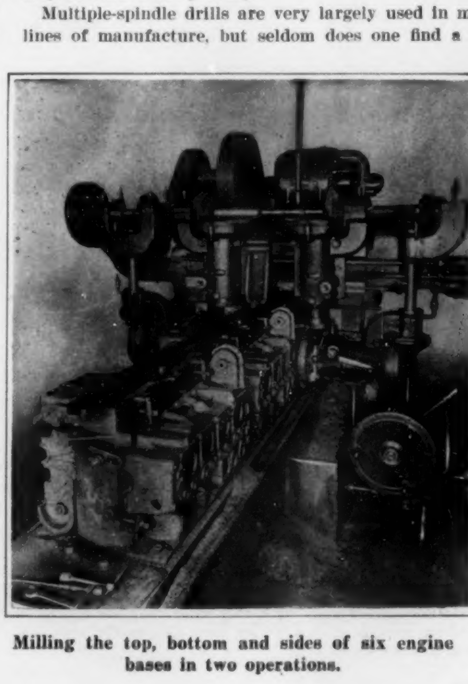
Multiple-spindle drills are very largely used in many lines of manufacture, but seldom does one find a machine as large as the one here illustrated. It is employed in drilling the holes in the frame side-bars of a certain type of car. The machine extends the full length of the side-bar and consists of a gang of six multiple-spindle drill-heads, all of which operate simultaneously on the work. Three of these enormous machines are required to drill the holes in a single side-bar. One puts the holes in the top of the bar, another in the side, and the third in the bottom. These three machines with six operators and a sub-foreman will do as much work in a day as twelve single machines with twelve operators, formerly. But not only is time and labor saved by the employment of this multiple machine, but the workmanship has been carried to a finer degree of accuracy. Another illustration shows a battery of multiple drills arranged in line along a track upon which run the jigs that carry the cylinder castings. The jig is moved from drill to drill, and rapidly centered under each, until all the holes in the castings are bored.

In last week's issue of the SCIENTIFIC AMERICAN we showed some horizontal milling machines operating on fifteen and thirty castings at a time. On this page we show a horizontal milling machine in which only four cylinders and crank cases are milled at a time. The machine is interesting however for the size of its milling cutters. The larger one is 22 inches and the smaller one 12 inches in diameter with inserted tooth cutters. After the work has been set up on the table it takes forty minutes for the revolving cutters to face off the opposite ends of the castings. Another milling machine, here shown, operates on six engine bases at a time, which pass between and beneath four large milling cutters, two of which are 15½ inches in diameter. In this machine the top and side of three engine bases are milled while the bottom and opposite sides of three more are being machined. The milling machine replaces four former machines and four operators. With two operators it can turn out 75 engine bases per day. However, the control of the machine

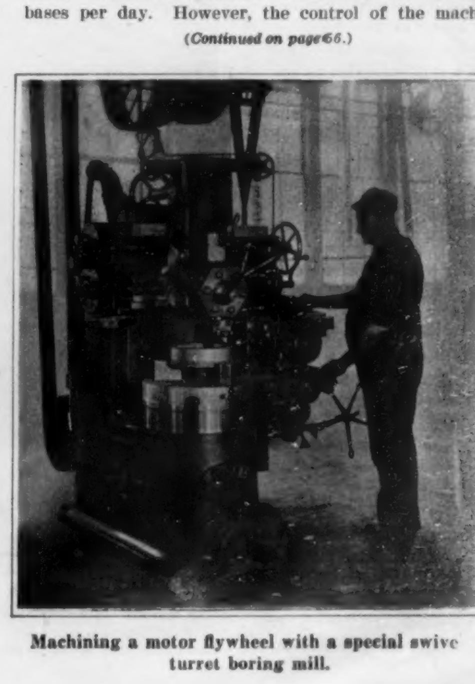
(*Continued on page 66.*)



Horizontal milling machine with 22-inch and 12-inch cutters.



Milling the top, bottom and sides of six engine bases in two operations.



Machining a motor flywheel with a special swivel turret boring mill.

# A New Mechanical Tunneling Machine

## A Machine That Drills Into Rock, Loosens the Material and Removes It to Cars

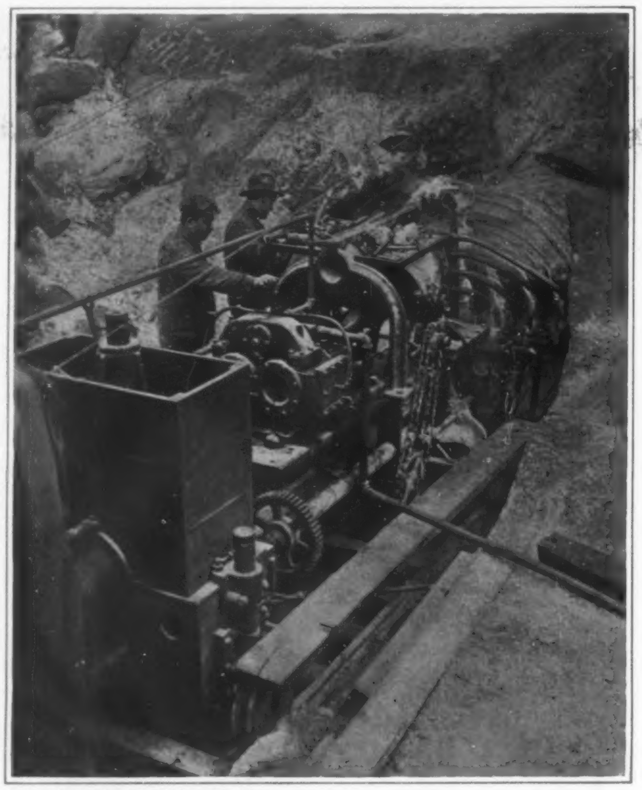
FOR many years inventors have attempted to provide excavating machinery which would drill into the rock face of a heading, loosen the material and remove it to spoil cars at the rear of the machine for transport to some place of disposal outside. Many different forms of tunneling machines have been invented, but few, if any of them, have been able to stand up under hard work, largely on account of the effect of the rapid oscillation of their power drills and the constant jar and vibration of the entire machine. Furthermore, the continual renewal of the drills in all such machines has been an important and expensive item and has acted against their success.

In its issue of January 19th, 1909, the SCIENTIFIC AMERICAN described and illustrated a promising type of tunneling machine which powdered the rock by the direct impact of twenty-five piston drills mounted on a rotating head. This machine had an extensive trial in service, but failed to meet the anticipations of its promoters. It was found that, like other tunneling machines, the fundamental principles of its design were faulty. The lack of success did not discourage the company which had developed the machine from further efforts in this field, and as a result of the efforts of Mr. Oliver O. App, the inventor, a new machine has been evolved on different lines which, for several months, has been under practical tests that are encouraging.

An experimental installation of this machine has been made at Marble Hill, 223rd Street and Broadway, New York city, where an open tunnel has been driven through the crystallized lime and quartz found at this point. With a full-sized machine, but with somewhat limited power, an effective demonstration of its working has been made, and a tunnel from 20 to 25 feet in length has been excavated through the extraordinarily hard rock there found.

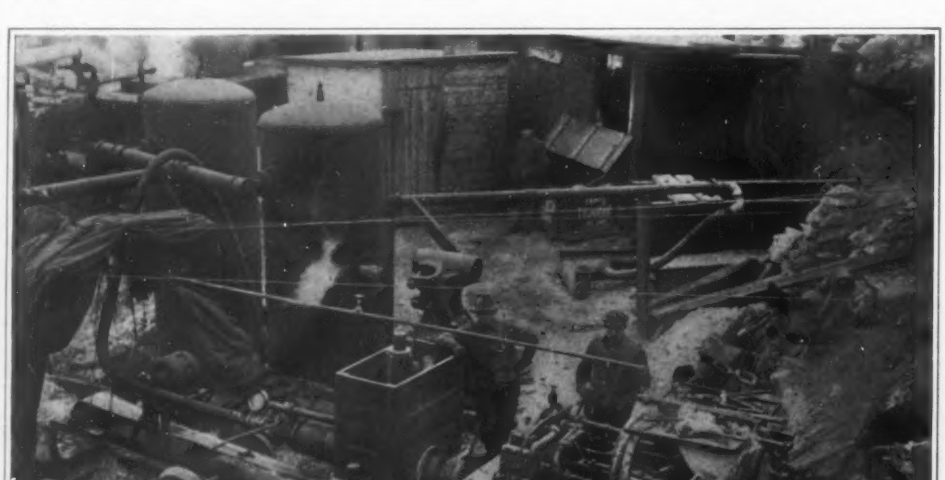
The present machine consists of a rotary head carrying fifteen powerful pneumatic rock hammers which are directly in contact with the surface of the rock and revolve with the head. Instead of the piston type of rock drill used in the earlier machine, the new tunnel excavator employs drills of the hammer type chipping away the rock like the hammer and chisel of the stone cutter. The arrangement is such that the entire operation is automatically controlled and operated from the time of contact of the cutting tools against the face of the rock to the removal of the muck. It is here that the machine shows its superiority over other tunneling machines, for where the drills would operate whether there was any resistance or not, and in so doing would produce a very destructive vibration, in this machine the action takes place only when the cutting tool is directly against the rock, as the hammer does not strike the steel unless this condition is observed.

The construction of the machine will be seen from the illustration. A revolving head carries the fifteen pneumatic drills, together with hydraulic jacks mounted at the upper part of two transverse diaphragms. These jacks are secured into the roof and fix the position of the machine firmly in the excavation. The head is moved against the surface of the rock to be excavated, and the drills, mounted on several holders, are individually and successively adjusted. The machine itself is carried on wheels running on rails of standard gage, 4 feet 8½ inches, and its engine can be operated by compressed air, steam or electricity, air pressure being used in the present installation. As the main shaft revolves, the two screw jacks with a feed of 36 inches move the frame forward so that cutting tools enter the rock and the speed of revolution of the head and the progress depend upon the nature of the material to be excavated. In soft material, such as shale, two revolutions per minute can be made, with progress of an inch per minute, or five feet an hour, while with very hard material, three, four or more minutes may be required for a single revolution. The center shaft carries the head and feeds forward the limiting distance of 3½ feet, after which the machine itself must be moved forward and set with the hydraulic jacks. Both the forward and rear diaphragms can be moved together or independently. The shaft itself is hollow, 12 inches in diameter with an 8-inch bore, from which compressed air is led to the pneumatic drills on the head. On either side of the head there is a shovel with a capacity of from two to three cubic feet to scoop up the broken material and pass it through a hopper into a belt conveyer which removes the muck to narrow gage cars at the rear running on two tracks of 18-inch gage. The rock is not cut but appears in the muck as if it were lifted off in layers where the rapid concussion had disintegrated the material. In this way the common mistake of attempting to cut the rock is avoided, for it is realized that rock may cut steel quite as readily as steel will cut the rock. Consequently, when this excavating machine is put in adjustment the tools must be arranged so as to chip the rock. When the tools are in proper adjustment, each single tool must be set and locked.



Photograph by Underwood & Underwood, N. Y.

**A tunnel borer that eats its way through rock, stone and sand.**
Fifteen powerful rock-cutting pneumatic hammers strike over 1,000 blows each, with 25-pound hammers. A revolving disk carries the hammers.



Photograph by Underwood & Underwood, N. Y.

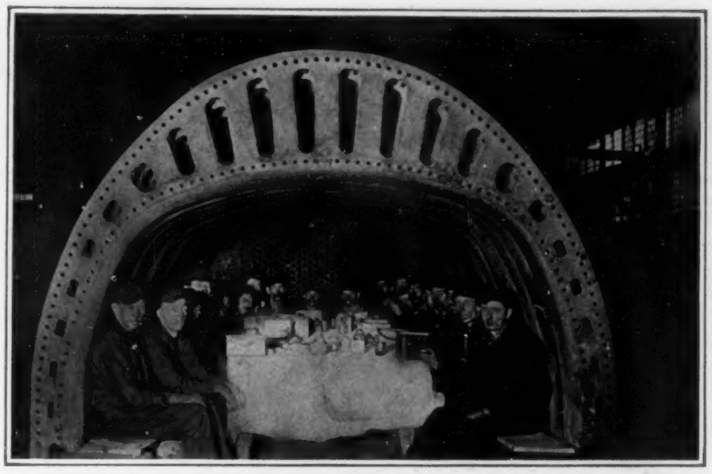
**The new tunneling machine.**
The machine is so constructed that the cutting tools work only when they are against the rock, each tool being cut off automatically when its share of the work is done, allowing those with harder work to do, to catch up. The action is similar to that of an auger boring through wood.

### Researches at Kilauea

IN the November number of the *American Journal of Science* F. A. Perret publishes the seventh and last of a series of articles describing the remarkable investigations carried out at the crater of Kilauea, Hawaii, in the summer of 1911, through the co-operation of the Massachusetts Institute of Technology, the Carnegie Geophysical Laboratory, the Volcanic Research Society, and residents of Hawaii. A regular vulcanological observatory has since been established at Kilauea, and the investigations are still in progress. By means of a trolley, carried on a steel cable suspended over the crater, special thermometers were lowered into the liquid lava, which was found to have a temperature ranging from 1,050 deg. to 1,175 deg. Cent., though in virtue of its chemical activity the lava has the power of fusing metallic objects whose melting point is several hundred degrees above these temperatures. This paradoxical observation indicates that all estimates of the temperature of liquid lava based upon the melting therein of wires or strips of various metals are of practically no value. Samples of the molten lava were also collected by means of the trolley, and their subsequent examination led to some curious observations; e. g., that lava evolves much heat in solidifying, so that specimens maintained a stationary temperature for some three hours after being collected. A very important question, on account of its bearing upon the prevailing explanations of volcanic activity, is whether water of magmatic origin is found among the gases exhaled by active volcanoes. Its presence is denied by Dr. Albert Brun, who analyzed the lava specimens collected by Perret, but appears to be fully established by researches carried out in the summer of 1912, as reported by Drs. Day and Shepherd in the *Journal of the Washington Academy of Sciences* for November 4th, 1913. The later observers performed the brilliant exploit of descending into the crater and inserting a tube into the dome formed over a lava fountain, whence the gases were pumped into a number of collecting tubes. The latter were subsequently brought out of the crater, and the contained gases were analyzed. Considerable water was found to have condensed in all the tubes. Another notable discovery was that the nitrogen exhaled by the volcano contains no argon, and as the latter is always present in the atmosphere it is concluded that the latter does not contribute to the gases given off by the volcano. All the gases, including water vapor, evidently originate entirely within the earth.

## A Banquet in a Locomotive Firebox

THE accompanying photograph shows the interior of the largest Jacobs-Shupert sectional firebox yet built. This photograph was taken during the process of construction, and before the back head and door sheet had been applied. There are twenty men seated about the table within this firebox. This is one of a lot of fireboxes now being built for the Philadelphia & Reading Railway to be applied to their class I-8-A Consolidation locomotives. These locomotives are designed to burn anthracite coal, and hence the large grate area is requisite. These particular fireboxes will be built to form a combustion chamber between the bridge wall and the back flue sheet. The firebox consists of fifteen channel-shaped sections, each section being 10 inches wide over all. This firebox is 13 feet 2 inches long and 8 feet 8 inches wide inside dimensions. The distance from the bottom of the mud ring to the center of the crown on the inside is 5 feet 1 inch. It is expected that these fireboxes will be in service by next spring.



Twenty men seated about a table in an enormous locomotive firebox.

## Brickwork Statuary

JUST as the Babylonians of old, on the Istar Gate of the Royal Castle, used to build up of glazed bricks their well-styled, imposing animal monuments, an attempt is being made to restore the brick to its ancient place of honor in modern statuary.

Instead of fixing a raw block in position and hewing it with the chisel, as is frequently done with the reliefs on English houses, thereby laying the brick open to atmospheric influences, and destroying the remarkably picturesque charm of the vivid colored material, the monument is molded bodily out of the unburnt brick clay, cut into layers and stones and each finished up carefully. In the kiln the molded parts are laid on a sand bed, insuring perfect mobility during the baking process and excluding any risk of breaking or bending. A perfectly uniform shrinking of 15 to 16 per cent may be accounted for. When the monument is next erected on the spot, the insertion of a proper thickness of lime-cement mortar into the joints between the brick layers restores it to the originally contemplated dimensions.

The accompanying photograph shows a figure intended for the monument of an African explorer to be erected in a German sea town. It is the joint work of a sculptor, Mr. Edzard of Paris, and Mr. Donandt.

The monument, 33 feet high, grows out of a brickwork wall surrounding its base. The explorer, clad in his Moroccan burnouse, is shown astride on a camel, looking boldly out into the distance. This monument, rising above the river Weser, is to be a symbol of the spirit animating the seafaring population of the town which thus wished to commemorate the explorer.

A monument built of brick.

Home-made gasoline tractor.

## Up-to-date Corn Cribs

CORN cribs, like everything else, are liable to go out of date. The latest style is shown herewith. It is made of galvanized iron and concrete. It rests on the ground on a specially constructed circular concrete base which is guaranteed to make it absolutely mouse and rat proof and also weather-proof. It is an easy matter for the farmer to have his new style corn crib always full, for it is sectional like a sectional book-case, and therefore it may be enlarged or contracted to suit any crop. This one here illustrated was photographed at the Hamilton County Experimental Farm, near Mt. Healthy, Ohio, where several of them are in use.

Sectional corn crib that may be enlarged or contracted.

## Clouds Formed Over a Forest Fire

IN the forest and brush fires which burned over many square miles in what is termed the "Back Country" north and east of San Diego this fall, an interesting phenomenon was observed on two occasions, when photographic records were obtained by Mr. Frederick M. Smith, of La Mesa, Cal., who describes it as follows: "It occurred on September 14th and again on the 16th. The fire had been burning for several days despite the continuous efforts of hundreds of men working under the direction of the fire wardens, and had approached within from eight to twelve miles of La Mesa. Each time the phenomenon occurred on a clear, cloudless day. The first time as I watched the huge smoke columns filling the sky with their black pall, I noticed over one of the largest of the smoke columns a white cloud forming. It grew in size till it formed such a cloud as one frequently sees here hanging back over the mountains. A smaller one also began forming to the northwest of the larger one. The cloud was formed by condensation of the moisture driven up from the burning vegetation, and disappeared in a few moments. The phenomenon was repeated two days later, on the 16th, when a white cloud of peculiar beauty formed again over a heavy smoke column. It appeared like the snow-capped peak of some mountain; and resting as it did above the dense black smoke it presented a spectacle of striking picturesqueness, to which the accompanying picture does not do justice.

Cumulus clouds formed over a forest fire.

## A Home-made Gasoline Tractor

IT occurred to a young Illinois farmer recently that he could make far better use of his three horse-power gasoline engine if he mounted it on wheels and converted it into a tractor. The photograph published herewith shows how the finished machine looked. The following is Mr. Everett Price's description of his machine and his method of constructing it: "By watching the 'Old Iron Man's' scrap pile different things were picked up and made use of. The hind wheels and axle are from a mower; the front wheels are gang plow wheels on an iron axle; the steering gear worm is from an old straw stacker and the hand wheel is a balance wheel to an ice-cream freezer. When running machinery using a tumbling rod, I use the jack shaft. Its ends are squared to fit an inch knuckle and it has a large belt pulley from a threshing machine keyed solid to it. It is run with a friction belt tightened by a lever and idler pulley. The pulley came from a corn planter reel, and the two levers from a gang plow. A second lever operates the traction gear. When lever is upright jack shaft runs free. When thrown forward engine moves forward, and when back engine backs. The bevel gears are from a mower and feed grinder. The pinions on the jack shaft are feathered. The large gear on axle is keyed solid, and axle is keyed solid to one wheel. It only drives from one side, but does not beat badly. The lever near the steering wheel operates the governor and sparker at same time. The speed ranging from 140 to 550 r.p.m. When I got the engine the speed was changed by a thumb-screw on top of the governor, and the sparker with a wrench, but by a few simple attachments both are changed together, giving a great range in speed.

"When traveling on the road, I travel about three miles an hour. I sit on a swinging spring seat, and have a foot-brake to use when going down hill.

"The tools I run are many and varied, such as band-saw, wood-turning lathe, disk sharpener, post drill, emery wheel stand carrying two wheels 2x12, sickle grinder, forge, two feed grinders, one for shelled and one for ear corn, two hole sheller and bucket elevators, sausage mill, pump, grain dump, cement mixer, wood-saw and anything else which can be run by belt or tumbling rod."

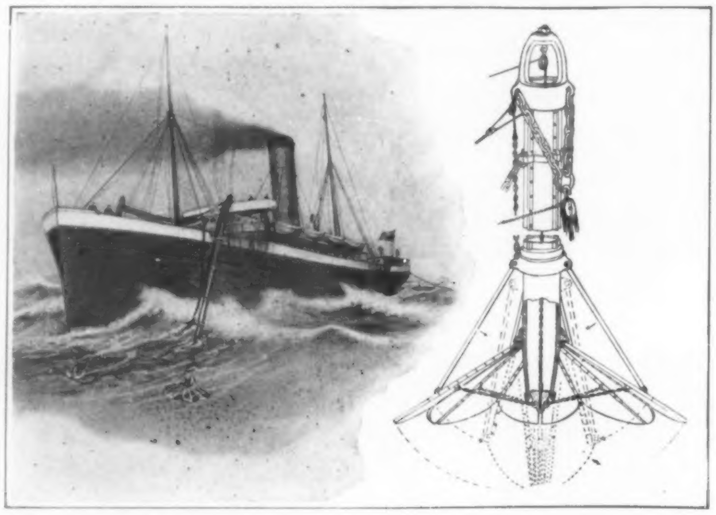
**Glass-Filling Drinking Fountain.**—A drinking fountain has been patented, No. 1,072,124, to Charles Edmund Kells, Jr., of New Orleans, La., which shows a drinking fountain in which a shield surrounds the discharge orifice from which the stream of water issues and passes through the shield without coming into contact with it. When the shield is adjusted to an inclined position the discharged stream may be received directly by the mouth of the drinker or may be used for filling a drinking glass.

# Inventions New and Interesting

## Simple Patent Law; Patent Office News; Notes on Trademarks

### Device for Releasing Stranded Vessels

THE accompanying illustration shows a device which has been patented by Mr. A. E. Luzzi, the object of which is to assist the wreckers in releasing a vessel which has stranded on a shoal or on the beach. It consists of a pair of stout, steel columns, whose principle of action is similar, on a large scale, to that by which a boatman poles himself off the beach, or by which the old Mississippi steamboats were wont to pull themselves off or across a shoal of the river. It consists essentially of the two columns, a system of chains which are slung beneath the vessel, and tackles and gear by which, through the hoisting winches, part of the load of the ship is transferred to the columns, and the operation of backing off the shoal is thereby assisted. The foot of each column consists of a folding base, consisting of a number of segments hinged together and also hinged to the base of the column, all in such a way that they can be opened out to provide a broad footing in sand or loose material, or closed up, as shown in dotted lines in our detail sketch, in order to afford a stiffer base of less area when they foot upon rock. When the base is open, it is supported against the column by a set of heavy steel rods, which extends from the outside of the leaves to a common sliding ring, which brings up against a fixed ring firmly attached to the column. A chain is run from the inner face of each segment and is attached to a common sliding block at the base of the column, which is drawn up or lowered by means of a chain, leading through to the center of the column. The vertical movement of the block serves to draw the segments into the closed position as shown by dotted lines. At the top of the column, which is extensible to suit the depth of the water and height of the ship, is a chain sling, and from this a block and tackle leads to the mast and affords a means for maintaining the columns in the desired position with regard to the ship. Heavy chains are passed around the hull abreast of the columns, and by means of heavy tackle, and the hoisting winches on deck or other suitable means of power, a heavy strain is placed upon the columns and a part of the load of the ship transferred to them. To ease the strain on the lifting gear when the ship is rolling, heavy coil steel springs are interposed between the base of the mast and the gear. By this means it is possible to transfer to the columns as much of the load of the ship as the columns will bear, and this lightening of the ship, coupled with the backing of the engine and the strain on the hawsers of the wrecking tugs is depended upon to release the ship and float her into deep water.



Device to assist in releasing stranded vessels.

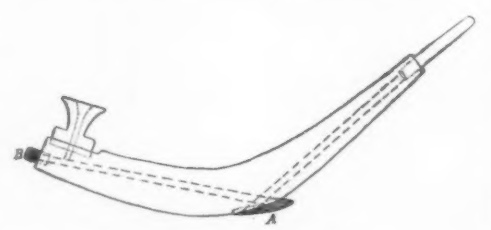
### The Eskimos as Aboriginal Inventors

By A. L. Kroeber, Curator of Anthropology, University of California

WINDOWS without glass, the carpenter's brace, the first decked boat, a type of self-supporting vault unknown to civilized architecture, an artificial arm, are only a few of the achievements to the credit of the Eskimo; while he has solved the problem of drilling a curved hole, or sawing without a saw, with ease. Twenty-five thousand to-day, perhaps fifty thousand all told before the diseases of civilization and alcohol had begun to draw them from the height of their prosperity, the Eskimo population from Greenland to Alaska has always been less than that of a second-rate city among ourselves. It is not amiss to say that they have produced more inventive geniuses, man for man, than any other people, not excluding the Anglo-Saxon race.

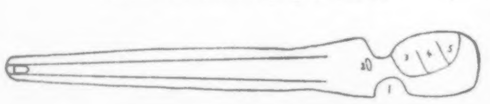
With the exception of but a few tribes, they live in a climate where wood and all products of the vegetable kingdom are unknown, except perhaps for such small quantities as the ocean currents may drift to their shores. One half the mineral substances, including the all-important metals, are also beyond their reach in the ever frozen north; even if they mined iron ore, they would not have the fuel to smelt it. Only products of animal origin—bone, skin, hair, and ivory—stone, and the elemental substances ice, snow, and water, are at their service.

The snow-house well illustrates this. The Romans and their predecessors worked out the true arch and vault, and the Mayas of Yucatan used the false arch, but the Eskimo builds a spiral vault, which needs no scaffolding. The details of this construction in snow have been previously described in the SCIENTIFIC AMERICAN of May 7th, 1910, so it need not be gone into again here; but one of the remarkable features is that when the house is completed, the builder is immured inside. This, however, is of little moment, for his bone or ivory knife slashes out in a few moments a door big enough to crawl through.



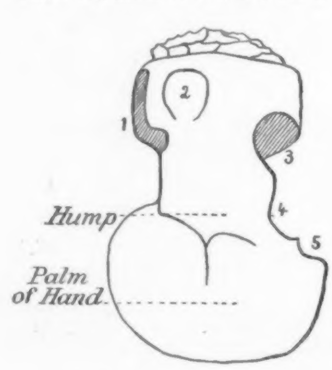

How the curved pipe is bored.

Note the detachable plugs *A* and *B*.



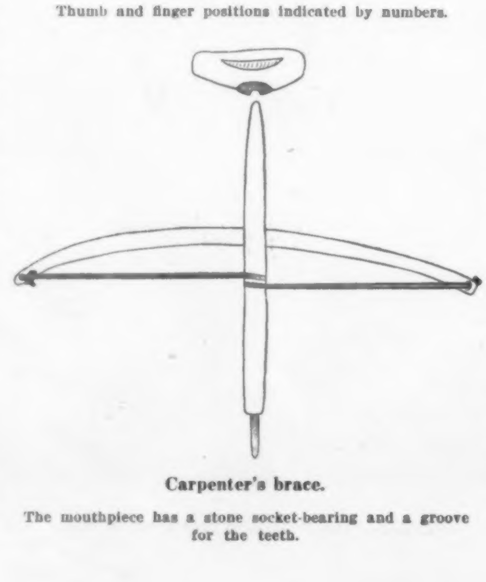
Left-handed spear thrower or artificial arm.

Finger depressions at 1, 2, 3, 4 and 5.




Woman's skin-scraper.

Thumb and finger positions indicated by numbers.



Carpenter's brace.

The mouthpiece has a stone socket-bearing and a groove for the teeth.

Next comes the window, which is cut out just above the door. How does the aborigine make this without glass? Nothing easier. He has saved up a seal bladder, or walrus intestine, and this, by the application of a little water, or when that is not at hand, saliva, is deftly frozen in a few instants into its frame.

This window is translucent, like our frosted panes; it admits light, but not vision. Something transparent is needed so that the inmates can see whether the clouds are clearing, or friends approaching. A slab of smooth ice, broken out of a leather bucket of water set outdoors for a minute, is therefore inserted in a hole cut in the gut.

Now Mr. Inuk, as he would call himself, is ready to move his family into their new quarters. But half a day of warmth from five or six human bodies, not to mention one or two cooking lamps, will begin to melt the snow walls from the inside. The inmates would soon be exposed to an ever increasing icy drip, until the roof disappeared over their heads. A system of portieres, or better, wall hangings, remedies this problem. Ten or a dozen old seal skins are hung by bone pegs just below the inside of the wall, leaving a narrow but clear air-space between the interior of the little cabin and its snowy exterior. The cold penetrates to this film from the outside; the slender heat inside does not penetrate beyond the skins; and all difficulties are avoided.

So, in a few hours, man, wife, children, and perhaps dependant old people, are comfortably installed; and that in a structure which not only can teach the engineer of civilization a lesson, but is provided by this so-called savage, and was provided by his ancestors, with wall paper and window at a time when our ancestors sat shivering in bare walls as far away as possible from the open windows they could not close without being in darkness.

But our Arctic genius is still far from the end of his troubles. Where the temperature is forty below zero, artificial heat is needed even indoors; and where meat is frozen so hard that it cannot be butchered, but must be chopped like wood, cooking is at least desirable, however strong one's teeth. Iron for furnace or range is not available; coal and wood not to be had; petroleum not yet discovered in the Arctic.

A stove is clearly out of the question. The apparatus must be a lamp. The material, it appears, must be stone. For fuel, seal oil, tried out from fat and blubber, can be used; and a wick can be made from dry moss. So the Eskimo shapes a triangular piece of rock, slightly hollows out the top, lays his wick along one side, pours on his oil, lights up—or rather his wife does so—and soon the pot is boiling and the pure snow melting into clean ice water for drinking. Such is the origin of the first oil cookstove invented.

But before meat can be cooked, game must be caught. In summer this offers no great difficulties, even in the Arctic. But in winter, when land animals are hibernating in hidden places, when fish lie torpid deep under the ice, when birds have flown thousands of miles to the south, and when the great pall of snow and ice covers the world, the Eskimo faces a difficult problem. If it were not for the air-breathing sea animals of the seal and walrus class he would starve in short order. But the seal cannot be hunted like other game. He has the intelligence of quadrupeds, and therefore net and hook and line will not catch him like fish. On the other hand, he lives in the water, and if wounded by arrow or lance would make good his escape, to die, perhaps, under the ice or out at sea, but out of the hunter's reach. Even if killed at the first shot, he would immediately sink, for strange to say, his body is heavier than water. The Eskimo therefore needs a peculiar weapon. It must be effective from a distance; and it must not only wound, but hold the animal. The need for such an implement has resulted in the invention of

(Concluded on page 56.)

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Pertaining to Apparel.

SEAM FOR SEWED ARTICLES.—J. BARRETT, 492 Howard Ave., Brooklyn, N. Y. This invention relates to a form of felling for edge seams of coats and other garments. It devises a method for securing together layers of cloth forming the edge of the garment in a way to make the felling almost invisible, while providing an edge seam felling that can be worked by machinery from the inside of the edge and finished with the same neatness as if felled by hand.

BUTTON.—A. B. COMMERFORD and SUSAN E. WATSON, 52 Ayrault St., Newport, R. I. This invention has reference to improvements in buttons such as are attached to garments, and has for an object the production of a strong reliable button of neat appearance which is formed of cord, tape, or other suitable material.

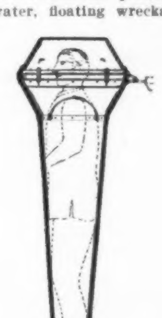
RING SETTING.—R. ROSENTHAL, 120 Chrystie St., New York, N. Y. The object here is to provide a structure for producing the same finish from the top of the setting downwardly through the ring. Also to provide an anchoring device and a reflecting device of the same kind as the fingers or prongs of the setting.

### Pertaining to Aviation.

PARACHUTE.—A. ODKOLEK VON AUGEZD, Baden near Vienna, Austria. This invention has for its object a mechanism for efficiently opening parachutes attached to persons or objects above the ground. Besides being a means of escape for aeronauts the device may be used as a fire escape in burning buildings, and serve for throwing up signal lights such as light balls, rockets or for firing projectiles from aeroplanes and balloons without subjecting the latter to recoil.

### Of General Interest.

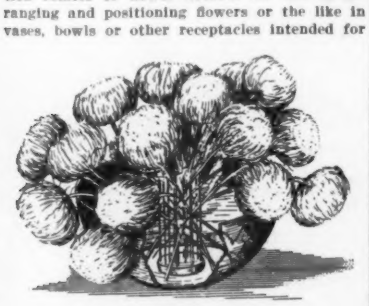
LIFE SAVING DEVICE.—E. E. HILLS, Medina, Wis. The purpose here is to provide a container which will receive and hold a person upright in the water and protect such person from the water, floating wreckage and other



LIFE SAVING DEVICE.

conditions under which the usual form of life preservers would be unavailing. The container is of such a nature that the same with others may be conveniently stored on shipboard and readily and quickly placed in operation in case their use is required.

FLOWER HOLDER.—W. S. DANIELS, 872 Lexington Ave., New York, N. Y. This invention relates to flower holders for use in arranging and positioning flowers or the like in vases, bowls or other receptacles intended for



FLOWER HOLDER.

their reception, and has reference more particularly to a device of this class which comprises a plurality of rods adapted to have the stems of flowers disposed among them to hold the flowers in place.

BUOYANCY TANK.—A. EHINGER, Keith Estate, Babylon, N. Y. The tank comprises a hollow body having means for admitting air and water, and so designed that the pressure of the water upon the outside, no matter what the depth of submergence may be, is always balanced by the volume of air on the inside, so that it is impossible for the tank to be crushed under any conditions in raising sunken vessels and other submerged objects.

UMBRELLA.—J. W. LEWIS, 124 Lower Terrace, San Francisco, Cal. This invention has for its object the provision of a simple and efficient means for detachably connecting the ribs and braces to the stick and runner respectively, wherein each connection is independent of the other connections.

SMELTING OR REFINING OF METALS AND THE LIKE IN CRUCIBLES.—H. G. SOLOMON, 4 Elgin Court, Elgin Ave., Maida Vale, London, England. This invention relates to induction furnaces applicable for crucible smelting and refining purposes. The object is to provide an improved form of induction furnace which shall be particularly, though not solely, applicable to the crucible process for making steel and steel alloys.

SECTION LINER.—B. SILVERSTON, 22 E. 120th St., New York, N. Y. This improvement has reference more particularly to that class comprising a member having means to engage another member so as to form parallel lines in any desired direction and having any desired spacing between the said parallel lines.

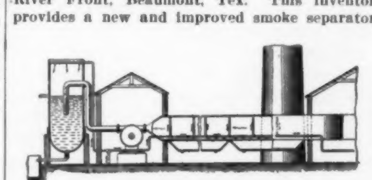
### Hardware and Tools.

RAZOR GUARD.—W. L. KING, 32 N. 9th St., Indiana, Pa. This attachment guards the cutting edge of the razor against accidentally cutting the face of the user, and the clamp element and the guard are so arranged, that the latter will exert a pressure against the clamp to bind the same against the razor blade.

WRENCH.—O. P. CASE, care of A. W. Davis, Canandaigua, N. Y. In this case the invention is particularly adapted for embodiment in monkey wrenches and relates especially to novel means for holding the movable jaw of the wrench in adjusted position relative to the fixed jaw.

### Heating and Lighting.

SMOKE SEPARATOR.—C. F. HOLMES, 37 River Front, Beaumont, Tex. This inventor provides a new and improved smoke separator



SMOKE SEPARATOR.

designed for use in connection with smelter furnaces and other apparatus, and arranged to effectively prevent poisonous or obnoxious gases from passing into the atmosphere, at the same time retaining and saving valuable matter contained in the smoke.

SOLAR HEATING APPARATUS.—M. DE LA GARZA, 403 S. Campbell St., El Paso, Tex. This invention provides an improved lens, and improved means for adjusting the frame carrying the lens, lens tube, and a casing to contain a heater or other apparatus. It is designed more particularly as an improvement on the apparatus forming the subject of U. S. Letters Patent, No. 696,326, formerly granted to Mr. de la Garza, although features of the present invention are not limited for use with the patented apparatus referred to.

FEED WATER HEATER AND PURIFIER.—T. O. ORGAN, 116 W. Seymour St., Philadelphia, Pa. The heater is provided with an oil separator having an inlet for impure steam and an outlet for purified steam, said outlet being located in the wall of the separator opposite the inlet, and provided with a flange projecting toward the inlet and an oil outlet forward of the steam outlet, a chest, the inlet of which is formed by the purified steam outlet of the separator. The chest has an outlet to the heater's interior, and a valve in the chest and controlling its outlet. The invention relates more particularly to the one disclosed in Letters Patent of the U. S., No. 781,453, formerly granted to Mr. Organ.

### Household Utilities.

FLUSHING DEVICE.—N. J. GONDOLF, 703 State St., New Orleans, La. This invention is intended for flushing tanks having a siphon, and a siphon starter that supplies a jet to the shorter leg of the siphon to start the action. It provides actuating devices for the valve means that command the water inlet, so arranged that the opening of the valve to start the siphon will be accomplished without submerging the ball float.

COLLAPSIBLE WARDROBE.—J. A. HAZZARD and A. B. JONES, 1 Emily St., Cambridge, Mass. This dust-proof compartment can be suspended in any desired place, can be easily collapsed to a compact package of convenient size for transportation and the parts are so interconnected that none can get lost. The parts constituting the wardrobe may be quickly and securely assembled to form a dust-proof compartment.

BEDSTEAD KNOB.—S. J. FLETCHER, Shepherd St., Ashfield, New South Wales, Australia. The object of the present invention is to effect certain improvements in bedstead knobs whereby the latter are supported more firmly, the provision of the screwed nut in the knob is obviated and the adjustment or removal of the knob may be more quickly effected.

WINDOW WASHER.—G. D. GIOVANNI, 460 E. 171st St., New York, N. Y. This invention refers to improvements in window washers, and has for an object to provide an improved structure which may be adjusted in position and then operated until the window to which it is connected has been thoroughly cleaned.

### Machines and Mechanical Devices.

FLASH MACHINE.—J. L. COURSON, Barberton, Ohio. This inventor provides a construction which includes a number of receptacles receiving the materials for producing the flash, together with suitable mechanism for causing the materials in each receptacle to be ignited in turn in a positive manner when the camera shutter is thrown open to make the exposure for the picture that is to be photographed.

FABRIC FOLDING DEVICE.—H. S. BURNHAM, Lawtons, N. Y. This invention relates to fabric folding devices for use with sewing machines and the like, and has reference more particularly to a device of this class, which includes continuously movable means for rolling under the edge of a fabric to form a hem.

DATING MACHINE.—E. E. GREGORY, Central City, Ky. Mr. Gregory's invention relates to dating machines, particularly for use in banks, real estate and loan offices, and more particularly to an apparatus embodying stamp-

DATING MACHINE FOR BANKS, OFFICES, ETC.

ing wheels for the years, months, and days of the months, having means for advancing a predetermined number of days through a single actuation of a certain portion of the machine for this purpose.

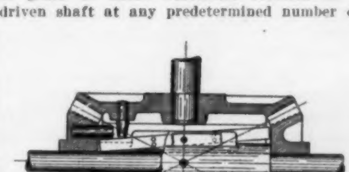
TRANSMISSION GEARING.—J. CHALMERS, 60 Edison St., Quincy, Mass. The object in this instance is the provision of an improved structure in which power may be transmitted from one shaft to another through a plurality of gearing designed to change the ratio of rotation at the will of the operator.

AUTOMATIC CHUCK.—D. W. WOOD, care of McNutt & Shattuck, 12 G. A. Knight Block, Brazil, Ind. This invention relates particularly to a holder to be used on turret lathes, screw machines, or wherever an automatic chuck with a changeable collet is desired. By this invention the engagement of the hood with the spindle may be disalined or worn out without in any way affecting the alinement of the collet itself.

CAMERA.—A. VORIS, 15 Cottage St., Jersey City, N. J. This invention relates particularly to devices having a reflecting mirror and a focusing plate, which will permit the operator to view a full-sized image. The apparatus is foldable in compact casing when not in use, and may be unfolded or extended for taking a comparatively large negative.

BOX MAKING MACHINE.—G. M. WESTLAND, 802-804 Main St., Winnipeg, Canada. This invention provides a holder with means for indicating the proper place of the parts of the box and for holding such parts in place and so arranged that while the holder is firmly held in place on the support, yet it may be changed in position to bring the work into the successive various positions necessary for the different operations.

AUTOMATIC REVERSING MECHANISM.—T. H. PHILLIPS, JR., 33 Ridgewood Ave., Brooklyn, N. Y. The invention depends on the ratio of gears to cause automatic reversal of a driven shaft at any predetermined number of



AUTOMATIC REVERSING MECHANISM FOR WASHING MACHINE, ETC.

revolutions or with a fraction thereof. The mechanism can be used on washing machines, churns and topping machines. There are no cam wheels, dogs and ratchets, star wheels, sliding clutches or keyways or step by step operations to cause reversal.

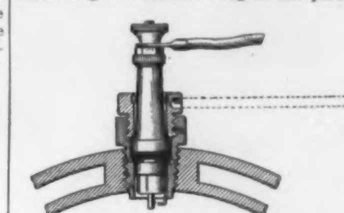
FIRE ESCAPE.—H. CROTEAU, 23 Villeneuve St., Montreal, Canada. This invention is so constructed that it requires but little power to operate the same, and is preferably in the form of an endless carrier moving over pulley wheels at the top and bottom, and being provided with rungs on which the persons escaping from the building can support themselves.

PACKING MACHINE.—J. HOCHENAUER, 2616 Grand Ave., Pueblo, Colo. This invention has reference to packing machines and more particularly to a double packing machine, the object being to provide simple attachments for actuating two packers in unison, doing away with all friction and other clutches and adapting the packers to run continuously.

FRICTION GEARING.—C. N. WHIPPLE, 1019 Nora Ave., Spokane, Wash. The purpose here is to provide a device wherein means is provided for connecting a driving and a driven shaft by means of which the relative speed of the shafts may be varied without stopping or slowing either, and without any danger of breakage, stripping gears or the like.

### Prime Movers and Their Accessories.

SPARK PLUG.—J. J. MEYER, Yonkers, N. Y. This invention relates to internal combustion engines, and its object is to provide a spark plug arranged to allow convenient and quick assembling and disassembling of the parts for



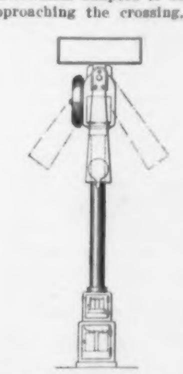
SPARK PLUG.

removal of the electrodes for cleaning, repairing or other purposes, and to protect the assembled parts against injury by vibration or jars incident to the running of the engine.

### Railways and Their Accessories.

CAR COUPLING.—H. R. SWAN, 938 Fifth Ave., Huntington, W. Va. The object here is to provide an arrangement of structure whereby a gravity latch member may be utilized upon the tail of the knuckle and the parts moved toward and from the closed position without the destructive friction between the knuckle parts and the drawhead which is usually present in such arrangements to the detriment of all the parts.

CROSSING SIGNAL.—W. A. HESSE, Alameda, Cal. This invention is particularly directed to mechanism adapted to be actuated by a train approaching the crossing, the control



CROSSING SIGNAL.

being effected by means of a suitable electric circuit. The principal object is to provide a crossing signal adapted to be actuated when a train approaches the crossing in order to give warning to those in the vicinity of the crossing, the construction contemplating a signal characterized by an oscillating arm.

### Pertaining to Recreation.

AUTOMATIC FISH HOOK.—F. FORRESTER, 124 Second St., Elizabeth, N. J. This device has connected thereto pivotally a plurality of individual fish hooks and also has means whereby when one of said hooks is struck by a fish, a pull upon the line will cause the other of said hooks to become operative or to increase its catching tendency.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

### Protecting East St. Louis Against Floods

(*Concluded from page 44.*)

will work its way southward, filling the river between the new shore line and the levee for a distance of three miles.

The levee wall in front of East St. Louis is for a considerable distance about ten feet higher than the street level, while the Mississippi River at low stage is considerably lower than the street level. It would be an unnecessary waste of energy to drive the teams and trucks over the top of the levee wall and then down over the wharf to the boats, so the engineers constructed the levee to suit the conditions prevailing at the high and low stages of the river. When the river is at low stage the teams are allowed to pass directly from the street level on inclosed inclined planes running parallel to the levee wall through openings in the main levee wall. At the top of the inclosed inclined planes flood gates have been built. When the Mississippi River is high these flood gates are closed, and the teams pass over the levee wall by way of other inclined planes. This scheme enables the teams to reach the boats conveniently during high and low water.

Moving south we find the Cahokia Creek flood gates. These are operated on the same principle as the smaller gates we saw farther north. They hang vertically and the pressure of the water from the Cahokia Creek opens them. When the Mississippi River is high its pressure keeps them closed. South of Cahokia Creek the levee is the same as it is north of Madison.

### Going Through the Shops

(*Concluded from page 51.*)

does not take all of their time, for they also run a grinding machine which grinds the top of each crank case where the cylinders fit on. A similar machine is used for milling both ends of the engine base at one set-up. Two special fixtures carry eight front supports and eight rear supports and enable one operator to turn out eighty pairs per day, whereas, formerly, four machines and four operators were required to do this work.

A special boring machine used for retouching and finishing the rear end of a crank case and engine pan is shown herewith. A double-ended star feed mechanism is mounted on rigid spindles. One set of cutters squares off the end of the crank case to the correct length, another set recesses it to proper depth to receive the forward end of the transmission piece, all of which is done automatically. Our last illustration shows a special boring machine operating on a flywheel. In the swivel turret head are two pairs of tools for machining the edge inner face of the wheel while still another tool operates on the outer face.

These fragmentary notes will give but a fleeting impression of the countless labor saving appliances and processes employed in a motor car factory. Lest one may gain the impression that labor is saved at the expense of accuracy we shall describe in the next installment the rigid tests which various parts, as well as the completed engine, must undergo in the high grade factory.

### Aboriginal Inventors—the Eskimo

(*Concluded from page 54.*)

the harpoon, which the Eskimos have perfected beyond all other nations.

The harpoon is a lance with a long line attached. This rope, made of the skin of previously killed walruses, is, however, fastened not to the harpoon itself, but to its point. This point, or toggle-head, is detachable. While the missile is in flight, or penetrating the victim's body, the head is end on, presenting its sharp point. Once in the body of the seal, the head comes loose, turns broadside, and is prevented by this position, as well as its barbs, from being pulled out. The shaft, or harpoon itself, comes out, floats on the surface, or hangs free from the line. On the other end of this line, however, is Mr. Eskimo, holding on with a death-like grip. If he is hunting at sea, his boat may be dragged for miles. But at last the seal tires, he hauls it close, and when it comes up to breathe, another harpoon, or a plain lance, is plunged into it until it expires. And then not only he, but his family, and their friends, have plenty for some days.

This sounds easy, but the Eskimo knows better. The seal has the keenest of scent and hearing, and is difficult to approach closely. On the other hand, the elaborate harpoon, if big enough to hold a large animal, is heavy, and can be thrown only a short distance. If the Eskimo were twice as big as he is, he could throw twice as far. If only his arm were double length, he could hurl double the distance. But he is a stumpy fellow, muscular indeed, but short limbed. Well, what does this surprising individual do but make himself an artificial arm which lengthens his natural limb by fifty per cent!

The "spear-thrower" is what this apparatus has been called; but it is indeed an artificial limb. Even the most skeptical become convinced when they can see and feel the grips for each finger. A large groove in one edge exactly accommodates the thumb. In the other edge is a depression, or rather a series of three, into which the three last fingers of the hand fit neatly. The index finger has a hole all for itself on the under side, to give a good grip; this hole is just carried through, so that the nail of this finger coming from below almost meets the thumb.

The remainder of the implement is simple, consisting of a long, grooved extension, into which the butt of the harpoon fits, being held at the end by an ivory hook or peg. From this peg the spear is really propelled. As the "thrower" rises into the air with the arm, the spear is released by the clutching fingers, until, when the implement is vertical, the harpoon flies forward.

The increased effect of the "thrower" is also easily calculated. Assuming that it is sixteen inches long, it adds one half to the length of the arm. Now the arm forms the radius of a circle, or part circle, in which the extremity moves that propels the spear. If the radius is lengthened by half, this circle is increased by half. The spear covers this enlarged distance in the same time as it would if held in the unequipped hand; hence its velocity is half as great again. The velocity being higher, the distance traversed by the missile will be greater. Hence the implement adding fifty per cent to the length of the natural arm, adds also fifty per cent to the range of the Eskimo's harpoon, and more than doubles his chance of striking the game.

The same patience and ingenuity are displayed in carving out ivory handles for the stone-bladed knives which the Eskimo woman uses for scraping skins. Each finger, and even the palm of the hand, has its particular notch or exactly fitting depression, so that every part of the hand may obtain a firm grip and every ounce of effort be utilized.

With all the work she does, the Eskimo woman's hand remains small and delicate. Her scraper will only fit a lady's hand. A man, Eskimo or white, can no more properly grasp her tool than he could put his foot into Cinderella's slipper.

The scraper, as well as the spear-thrower, is of course carved individually to fit a particular person's hand. This enables one to tell at a glance whether the man or woman who owned it was right or left handed. Ninety-nine per cent of the implements for either sex are for right-handed people. Evidently right-handedness is not a product of effete civilization and school training, as we are apt to think, but goes back to savagery.

Though no tobacco grows in his land, the Eskimo dearly loves to smoke. Strange to say, while inhabiting a part of that continent which first gave tobacco to the world, the Eskimo uses a pipe of Asiatic type and origin, as shown by its small steep bowl and curved stem. How to bore a hole around the corner in this stem is no trick at all for our aborigine. He drills from both ends, and then starts two more holes at the middle of the side, which meet the first two. When the junction has been made, as in a tunnel bored from

## INQUIRY COLUMN

READ THIS COLUMN CAREFULLY. You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. *In every case it is necessary to give the number of the inquiry.* Where manufacturers do not respond promptly the inquiry *may* be repeated.

MUNN & CO., INC.

*Inquiry No. 9346.* Wanted the name and address of parties manufacturing tobacco stripping machines, and other machines pertaining to cigar manufacturing and cigar banding machines.

*Inquiry No. 9347.* Wanted the name and address of an industrial school where shoemaking is taught in all its branches.

*Inquiry No. 9348.* Wanted the name and address of manufacturers having useful household necessities, with a view to obtaining exclusive territory for a house to house canvass.

*Inquiry No. 9349.* Wanted the names and addresses of the makers of machinery for making Malt Tonic, also a machine for making grease, and machines for applying plaster (Cement Gun).

*Inquiry No. 9350.* Wanted the name and address of the manufacturer of a printing press for the printing of tapes for clothing. The machine should preferably be worked by hand.

*Inquiry No. 9351.* Wanted to make some article out of wood which could be made from 2 inch ash, by party having 75,000 or more feet of waste per year which is now used for fuel.

*Inquiry No. 9352.* Wanted the name and address of a person who is in a position to get the state or county agency for articles of merit that can be sold to business houses or others at $3.00 or over. No kitchen utensils desired

*Inquiry No. 9353.* Wanted the name and address of a manufacturer who can make flexible oil cans.

*Inquiry No. 9354.* Wanted the name and address of a manufacturer of a machine which will stitch silk around small metal rings.

*Inquiry No. 9355.* Wanted the name and address of the maker of triplex glass.

*Inquiry No. 9356.* Wanted the name and address of a manufacturer who can build an *automobile wheel*, also a *cigar vending machine*. Concerns in the middle West preferred.



opposite sides of a mountain, all the entrances but one are neatly closed with tight-fitting plugs, and a single airchannel extends from bowl to mouth-piece.

The drill with which this work is done is as ingenious as our best carpenter's braces, though simpler in construction. The bit is a stick with a hard sharp-pointed stone set in the end. It is turned by a string looped around it. The ends of the string are knotted to a curved ivory bow. When the workman fiddles this back and forth, the string of course moves with it, and the drill is twirled. To hold it up and steady, a snug socket is set on the top; and the oval piece that contains the socket is shaped to fit—the mouth. Thus the workman grasps it with his teeth, leaving one hand free for the operation of the bow, and the other for holding or manipulating his material. So in this device there is truly the origin of the carpenter's brace, just as Eskimo tools and appliances always evince the height of aboriginal inventive power.

### Smut Diseases and the Threshing Machine

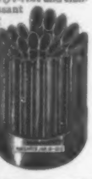
THAT the threshing machine is one of the principal means of spreading smut diseases in grain is emphasized in a recent article by H. T. Güssow, Dominion botanist of Canada. A machine that has been used for threshing smutted grain is so fully infested with spores that any grain subsequently threshed, unless the machine is properly sterilized after use, will become liable to infection. Moreover, in traveling from one farm to another the infested machine scatters spores along its route. Dr. Güssow urges the enactment of legislation against this evil analogous to that already in force in some provinces of Canada against the spreading of weed seeds by threshing machines. The laws requiring that the machines be swept free from seeds after use should also require thorough disinfection, which may be readily carried out by inclosing bags or sacking soaked in formalin solution in the machine for a few hours, and spraying the exterior parts and implements with the same solution.

### Maize Sugar

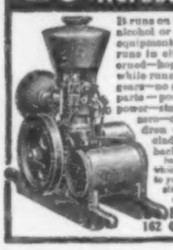
MR. O. W. BARRETT, the versatile horticulturist of the Philippine Bureau of Agriculture, takes a hopeful view of the possibility of maize becoming a serious rival of cane in the sugar market, and advises Philippine planters to experiment along this line, notwithstanding the unsatisfactory results of experiments already conducted in the United States. The maize plant, when deprived of the ears at the time starch is being deposited in the kernels, i. e., when the seed is "in the milk," develops a remarkable saccharose, or rather glucose content. Thus, the agricultural chemist of the Rhodesian government finds as high as 12½ to 14 per cent of sugar and about 1 per cent of glucose in the decobbed maize stalks in his experiments, which is above the average yield from sugar cane. Mr. Barrett quotes the opinion of experts that maize "will be, through its wonderful variability under the hybridizer's hands and its adaptation to man's varied needs, the greatest crop of the future."

### How to Make a Measurer of Liquids

A VERY simple method for making a container for liquids which measures off say a quart at each time the liquid is poured, is to take a large cylindical can and put in a false bottom which holds about a quart between this and the bottom of the vessel. At one side of the false bottom is an opening which connects with the main body of the can, and on the other a tube leading to the mouth of the vessel, so that the mouth connects in reality only with the before mentioned space. This space being filled with the liquid, we tilt the can down so as to keep the level in the main chamber below the orifice and prevent further entry to bottom chamber, so that the bottom chamber now holds just one quart and can be emptied at the mouth of the can.









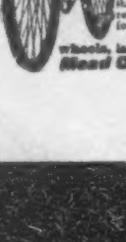














# Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12899) O. O. B. G. asks: 1. What force is it that causes a pendulum to swing up after it has fallen through an arc? The point of dispute is, one maintains that it is momentum, and the other says that it is inertia. Of course, the relation of the two is very close. A. Momentum is the force which carries a pendulum along its swing. Inertia is not a force. It is a property of matter. It expresses the inability of matter to move or stop itself. That is all there is to inertia, simple inability. Momentum is a force. It is measured by the product of weight by velocity. 2. Why is steel used to make springs instead of copper, or preferably to that metal? One party maintains that it is because the elasticity of the steel is greater, and the other maintains that it is because the tenacity of steel is greater. Also he (the latter) asks why, if the first is correct, that rubber is not used preferably to either of the others because it is most elastic of all substances. A. Steel is used for springs because it is both elastic and strong. Copper has very little elasticity, and little strength, or tenacity. Rubber is used for such springs as it is adapted to. It has a wide range of elasticity, and will stretch much farther than steel, but its elasticity is soon lost. Its elasticity of compression and stretching is valuable, but not its elasticity of bending. The elasticity of bending in steel is most valuable. Rubber is not the most perfectly elastic of all substances. Steel and glass are more perfectly elastic than rubber. Both retain their elasticity for many years, even indefinitely.

(12900) H. M. S. asks: Can you give me a formula for making bright red prints from photographic negatives by the ferro-prussiate process? A. A process for making red prints from prussiate paper is given in our "Cyclopedia of Formulas," page 701, price $5. "Float the paper 4 minutes on a bath of nitrate of uranium (not strong) drain, and dry. Expose under a negative for 8 to 10 minutes. Wash, and immerse in a bath of ferricyanide of potash, 30 grammes, water 3 ounces. When the print is red it is fixed in running water." You will find many processes for different tones in this valuable cyclopedia.

(12901) R. O. U. asks: Can you give me any information as to whether at any time there has been manufactured and sold a ball nozzle on which the ball was loosely laid in the cup of an ordinary nozzle, so that it would fall out if the nozzle were not held almost exactly upright, but when the water was turned on, it threw a very fine film of water without throwing the ball away? This seems to me a preposterous statement as I make it, yet several friends have vouched for it, claiming to have seen it in action, although the only ones that we could find in the hardware stores or at home had the ball O. K. but had a wire loop to keep it in position. A. The ball nozzle acts just as you describe it, although it seems strange at first thought that it should do so. The wire loop which is put across the mouth of the nozzle to hold the ball, is to hold it in place when the water is not turned on. As soon as the pressure of the water comes, the ball is forced in hard against the water and cannot fly away. The pressure of the air holds it against the water, and the water is spread in a spray over a very wide space. The explanation is very simple. You will find it in Hopkins, "Experimental Science," vol. 1, page 99, as the Ball Experiment. The ball forces the water to spread out as it issues from the nozzle, and thus the pressure is reduced below that of the air, and the air presses the ball into the cup of the nozzle.

(12902) A. Y. B. asks: Can a vessel be made of any other matter outside of glass that can retain a vacuum permanently? A. Any vessel of metal which is strong enough to withstand a pressure of 15 pounds per square inch may be used for vacuum purposes. It will hold a vacuum indefinitely, if the valves are made airtight at that pressure. The carbon dioxide cylinders and the oxygen and gas cylinders for the calcium light hold several hundred pounds of pressure for many months with very little leakage. They are of steel.

(12903) T. G. asks: Wishing to magnetize (permanently) a steel bar about 10 inches in length, I have wound nearly its entire length with twelve layers of No. 12, insulated, copper wire. There is a dynamo here, with a direct, maximum current of 2,500 volts. Now will you kindly favor me with a reply to the following: 1. Will it be sufficient to connect the ends of the coil, each with one of the poles of the dynamo? A. It will not be enough to connect your coil with one pole of a dynamo. No current can flow through a wire unless both ends of it are connected to the circuit, at points which are at a different potential or voltage. 2. Will a current of 2,500 volts be too strong for No. 12 wire, and should, therefore, a current of lower voltage be used? A. It will not be safe to connect your wire to the two poles of a 2,500 volt machine. The wire would be melted in a few seconds. 3. The manager of our local electric light plant says that on the loose ends of the wire, between the connection with the poles of the dynamo and the coil, one or more electric light bulbs must be affixed. Is that really necessary? A. You should have as many lamps less one as there would be placed in series for ordinary lighting. Let the coil be put in where one lamp would be put, and it will probably not overheat, and the current will magnetize the steel bar. 4. I have read that the magnetic or electric current does not affect the entire body of a wire or a bar of steel, but affects the metal only upon the surface and to a small depth below the surface. If this is true, will not a steel tube, with an inner diameter of 1 inch and a wall of 1-8 inch, containing three separate inner tubes (concentric), each also with a 1-8 inch wall, and each of the tubes magnetized separately, have far more magnetic (i. e. attractive) power than a solid steel bar of 1¼ inch diameter and of the same length. A. A magnet made of a number of thin pieces of steel is usually stronger than one made of a thick bar of the same weight. Probably steel tubes can be magnetized and fitted together so as to make a stronger magnet than a solid bar of the same weight.

(12904) C. E. O. asks: I write to you for information concerning the year 1900. Was it a leap year? And if not, please send me a SCIENTIFIC AMERICAN SUPPLEMENT explaining why it was not. Some say it was, and some say not. Please send also a list of all your SCIENTIFIC AMERICAN SUPPLEMENTS and Catalog of Scientific Works. A. The year 1900 was not a leap year, neither was 1800, nor 1700, but 1600 was, and 2000 will be a leap year. The ordinary year is 365 days 5 hours 48 minutes and nearly 46 seconds long. If one day is inserted every 4 years, which is 6 hours a year, this is too much by 11 minutes and 14 seconds, and by dropping the extra day three times in 400 years the calendar will be kept very nearly with the sun for many centuries. This was discovered by Pope Gregory XIII, and this calendar is for that reason called the Gregorian calendar. Pope Gregory XIII died in 1585, so that his calendar has been in use in Catholic countries since the beginning of the 17th century. In England it was not adopted till 1752, at which time the beginning of the year was shifted from March 25th to January 1st. Thus our present calendar has been in use but 161 years. You will find this in Todd's "New Astronomy," which we send for $1.45 postpaid.

(12905) G. A. C. asks: Can you tell me if there are firms which by some method make nitric acid from the air? A. Large quantities of nitric acid and nitrates are now made from the air by the agency of electricity. The principal plants are in Norway, where water power is cheap. We have frequently described them and reported their progress in our columns. We refer you especially to SUPPLEMENT 1640, 1641, 1642, 1643, 1644, 1667, 1668, 1691, 1692, 1746, 1748, 1784. These twelve numbers we will send you for ten cents each, and they will give you a wide view of what is being accomplished in this direction. Probably more than 100,000 tons of commercial fertilizers and reagents will be made this year by this process.

(12906) E. H. asks: Will you please tell me the deepest distance that a man has ever dived in a diving suit or other deep sea equipment? A. A man with a metal suit is said to have gone down 300 feet under the surface of the ocean. Men however do not work below 100 to 125 feet for any length of time.

(12907) C. A. B. asks: What influence has the moon, if any, on the weather? We think that an expression of opinion coming from so eminent a source as the SCIENTIFIC AMERICAN would be of great interest to a large number of your readers. A. The moon has no influence upon the weather, so far as the Weather Bureau has been able to detect, after a long time spent in studying the changes of the weather and the course of the moon. There is always a storm in progress somewhere around the world, and if a full moon occurs it is evident that it will be stormy where the storm or low barometer is at that time and fair where the high barometer is, while the change of the moon occurs at the same time to all parts of the country. Storms have no connection with the phases of the moon.

(12908) G. A. B. asks: Please to tell me through your paper how the temperature of the ocean varies with its depth in the torrid zone. At what depth does it reach the freezing point? A. The temperature of the ocean water does not reach the freezing point anywhere in the torrid zone. If it did, it would freeze and not be water, but ice. The lowest possible temperature below the surface of water everywhere is that of the maximum density. In fresh water this is at 39 deg. Fahr., and for salt water it is somewhat lower, but not much lower.

(12909) J. S. P. asks: Will you please explain the cause of the following mysterious experience? The writer with others, ladies and gentlemen, spoke in rotation into a recording phonograph. In the reproduction all the voices came out clearly except where the writer's should have been, but there the record was silent, not a sound. His voice perhaps was the heaviest of the company. The aim was to maintain the rate of revolution of the machine the same throughout. A. We have often noticed in testing voices that what seemed to the ear to be the stronger voice did not affect the recording stylus of the phonograph as much as a voice which seemed much lighter. We have attributed it to the fact that a heavy voice, that is, one of a low, deep tone, is frequently destitute of the upper partials which give fullness to the tone, and, we think, affect the recording apparatus more strongly than do the lower tones.